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LIVESTOCK AND THE ENVIRONMENT. A BIBLIOGRAPHY WITH ABSTRACTS

East Central State College

Prepared for
Robert S. Kerr Environmental Research Laboratory

April 1974

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16. Abstract

Management and research information on animal wastes has expanded rapidly in recent years. This material has appeared in diverse sources such as journal articles, conference proceedings papers, university or government publications, magazine articles, books, and theses. This bibliography (an updated and revised extension of the BIBLIOGRAPHY OF LIVESTOCK WASTE MANAGEMENT EPA-R2-72-101 which was published by J. R. Miner, D. Bundy, and G. Christenbury at Iowa State University) was compiled in order to speed the flow of information on findings in one segment of the livestock industry to other segments that could benefit from this technology. Included in this publication are the following indexes: (1) title, (2) author, (3) keyword, (4) animal information categories. These indexes are followed by a section of abstracts of each reference entry found in the bibliography. Single copies of most articles can be obtained in hard copy or microfiche form at cost from the Animal Waste Technical Information Center, School of Environmental Science, East Central State College, Ada, Oklahoma 74820. (Ramsey-East Central)

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LIVESTOCK AND THE ENVIRONMENT

A Bibliography with Abstracts

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ABSTRACT

Management and research information on animal wastes has expanded rapidly in recent years. This material has appeared in diverse sources such as journal articles, papers published as conference proceedings, university or government publications, magazine articles, books or book chapters, and theses. This bibliography (an updated and revised extension of the BIBLIOGRAPHY OF LIVESTOCK MANAGEMENT EPA-R2-72-101 which was published by J. R. Miner, D. Bundy, and G. Christenbury at Iowa State University) was compiled in order to speed the flow of information on findings in one segment of the livestock industry to other segments that could benefit from this technology.

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This report was submitted in fulfillment of Project Number R801454 by the School of Environmental Science, East Central State College, Ada, Oklahoma under the sponsorship of the Environmental Protection Agency. The work was completed as of January 31, 1974.

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SECTION I

INTRODUCTION

The evolving regulations and aims pertaining to the abatement and control of pollution have necessitated a timely and well-dispersed flow of pertinent information about the management and disposal of animal wastes. This is necessary so that capital investments in this area can be made on the basis of the most recent research and operational findings. Industry and manufacturing organizations or associations, in many activities, provide the linkage channels through which this information can flow. The wide range in operation sizes and makeup, the nation-wide dispersion of production units, the variations in climatic and geographical factors, and the dictates of the local or regional markets which are encountered in the production of animals or animal products make widespread dissemination of animal waste management information difficult. This occurs even though there exists an established communication network through publications from organizations such as breed associations, farm groups, or the popular agricultural press. Common properties and characteristics of animal wastes enable technological transfers to occur in the production operations from one species to another. Publicizing the existence of information on practices or findings in one segment of the livestock production industry can initiate new innovations or serve to spread the adoption of the new ideas to the other segments of the industry.

The objective of this project is to aid in the dissemination and technological transfer of information on the management and disposal of animal wastes throughout the livestock industry. Identification and location of pertinent information generated in the production operations of poultry, swine, cattle, fish, and other animals of economic interest raised in open or confined systems is accomplished through searches of technical journals, books, theses, reports from private, state and federal agencies, papers given at meetings of professional societies or symposiums, and articles appearing in the trade or production-oriented "farm" magazines.

The search topics of specific interest include the physical and chemical characteristics of animal wastes (manures and other material contaminated by manures); the operational and cost aspects of handling, collection, storage, transport, utilization, and disposal of animal manures; and the economic and legal impact of these wastes on the problems of air, water, and solid waste pollution. The articles identified in the search are collected and reviewed to determine if the contents are relevant to the project objectives. Those articles that are considered to be of value for the livestock producer or research scientist engaged in animal waste activities are abstracted and added to the collection.

An annual updated bibliography of animal waste management information will be prepared. It will contain entries and abstracts for all items maintained in the collection at the Animal Waste Technical Information Center.

It is anticipated that the information contained in this bibliography will show most of those seeking information where this material can be found, since many potential users will have access to libraries through which they may obtain the actual text of the material. However, single copies of most publications (those for which copying approval has been obtained from the copyright owners) may also be obtained upon request in hard copy or microfiche form at a cost-only fee. Information on this service can be obtained by writing:

Mrs. Linda Merryman, Project Librarian
Animal Waste Technical Information Center
School of Environmental Science
East Central State College
Ada, Oklahoma 74820

SECTION II

USER'S GUIDE

The entries in this bibliography have been assigned a specific cross-reference code. The code number consists of nine digits (example 100-73-1069) arranged in the sequences of a three-digit class code, a two-digit number representing the year of publication, and a four-digit accession number. The first grouping identifies the class of the document according to the following format (1):

Code	Class
100	Technical journal paper
200	Conference proceeding paper
300	University or government publication
400	Magazine article
500	Book or chapter from a book
600	Unpublished paper
700	Thesis

The next two-digit number is the year of publication or presentation. The last number is a four-digit accession number which identifies each article brought into the animal waste information collection.

This publication consists of 5 sections: Bibliography, Author Index, Keyword Index, Animal Information Category Index, and Abstracts. An explanation of each section follows:

BIBLIOGRAPHY

This section lists the items by classes according to the code defined above. The articles within these classes are arranged first by year of publication and then by accession number.

Each entry in the bibliography includes the cross-reference code, the author(s), the title of the entry, a list of keywords which help identify the contents of the material, and the bibliographical citation. An example of the format is shown below.

```
300 71 1257     BUTCHBAKER A F     GARTON J E
                EVALUATION OF BEEF CATTLE FEEDLOT W
                RNATIVES WASTE-TREATMENT-ALTERNATIV
                ROL BEEF-WASTE-MANAGEMENT
                WATER POLLUTION CONTROL RESEARCH SE
                OMA STATE     UNIVERSITY STILLWATER
```

AUTHOR INDEX

This index lists all the authors cited in the bibliography in alphabetical order. To the right of each author entry is the cross-reference code of the article or articles with which he is identified. An example of the format is as follows:

DUFFER W R	200 70 0698 300 71 1245
DUFFY M E	100 69 0265
DUGAN G L	100 72 0746 100 73 1184 300 70 0668

KEYWORD INDEX

This index consists of an alphabetical listing of significant words in an article or in the title of an article. To the right of the keyword are the first 85 characters contained in the title or the title and a listing of keywords, if the title is short. To the left of the keyword is the nine-digit cross-reference code of the article ascribed to by the keyword. The cross-reference code allows the user to enter the bibliography or look up the abstract for additional information about the title. An example of this index format is:

300 72 1157	DESIGN	CANADA ANIMAL WAST
600 69 1005	DESIGN	FACILITY DESIGN KE
600 71 0272	DESIGN	A DOSING-SIPHON FO
100 62 0499	DESIGN-CRITERIA	MANURE LAGOONS DES
100 65 0366	DESIGN-CRITERIA	LIQUID HANDLING OF
100 69 0353	DESIGN-CRITERIA	OXIDATION-DITCH TR
100 71 0266	DESIGN-CRITERIA	CAGED LAYER PERFOR

ANIMAL INFORMATION CATEGORY INDEX

To provide a quick entry into the abstract holdings of the collection, an animal information code was developed. This code utilizes an alphabetical entry to signify a broad interest area and a numerical digit to designate a more specific topic under the broad interest area. Each abstract in the collection was classified according to this code and could be listed under the five most relevant categories. This can provide the user an easy entry into the abstract holdings pertaining to his information needs. It is anticipated that some potential users, after reading some of the abstracts listed under these categories, may identify some particular keywords of importance which can be utilized to enter the more comprehensive keyword index to identify abstracts which may pertain to his more specific information needs. The code utilized in this index is as follows:

CATEGORIES OF ANIMAL INFORMATION

Interest Area	Topic Area
A. Environmental Effects	1. General
	2. Surface Runoff from Animal Production Unit Operation
	3. Surface Runoff from Agricultural Watersheds
	4. Groundwater
	5. Odor
	6. Air
	7. Biocides
	8. Vectors
	9. Health
	10. Aesthetics
B. Management of Animal Production and Confinement Operations	1. General
	2. Liquid Systems
	3. Solid Systems
C. Characteristics of Animal Wastes	1. General
	2. Physical
	3. Chemical
	4. Biological
	5. Management's Impact On
D. Treatment Processes	1. General
	2. Physical
	3. Chemical
	4. Biological
E. Utilization and Disposal	1. General
	2. Land
	3. Reuse
	4. By-Product Recovery
F. General	1. Economics
	2. Legalities
	3. Institutional and Policy Needs
	4. Overviews, Trends and Projections
	5. Related Agricultural Operations

The entries in this index appear under the code number as in the following example:

C 1

0001
0010
0023
0041

ABSTRACTS

This section contains the abstracts of the information entries contained in the bibliography. The abstracts have been published in Selected Water Resource Abstracts published by the Water Resources Scientific Information Center (2-82). Each entry, therefore, includes the title of the informational material, the bibliographic citation, the author or authors, keyword identifiers and descriptors, and the abstract. The abstracts are arranged sequentially by an assigned accession number which specifically identifies the article in the collection. To the right of the accession number are the animal information category code numbers assigned to the abstract entry.

SECTION III

BIBLIOGRAPHY

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100 55 0328   HUNGATE R E          FLETCHER D W          DYER I A
              EFFECTS OF CHLORTETRACYCLINE FEEDING ON BOVINE RUMEN MICROORGANISMS  KEYWORDS  FERMENTATION FEEDS LABORATO
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              LIQUID MANURE FOR MIDWEST SWINE PRODUCTION  KEYWORDS  LIQUID MANURE MIDWEST
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              THE MANAGEMENT OF LIVESTOCK MANURE  KEYWORDS  DISPOSAL VALUE STORAGE CN-RATIO COMPOSTING HOUSEFLY FERTILIZ
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              TRANS ASEA V 3 P 78-80 1960

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              EXCRETION STUDIES IN SWINE FED ARSANILIC ACID  KEYWORDS  ARSENIC FARM-WASTES SWINE DIETS FEEDING POULTRY A
              RSANILIC-ACID
              JOURNAL OF ANIMAL SCIENCE VOL 19 NO 1 JAN 1960 P 140-144    2 TAB 9 REF

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100 62 0382   GELDREICH E E        BORDNER R H          HUFF C B             CLARK H F            KABLER P W
              TYPE DISTRIBUTION OF COLIFORM BACTERIA IN THE FECES OF WARM-BLOODED ANIMALS  KEYWORDS  COLIFORMS E COLI FE
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              ICIDES FARM-LAGOONS FERTILIZERS CHLORINATED-HYDROCARBONS NITRATES INSECTICIDES  DDT SEWAGE-LAGOONS WASTE-D
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              TOXICITY TO HOUSE FLIES AND HORN FLIES OF MANURE FROM  INSECTICIDE FED CATTLE  KEYWORDS  TOXICITY FARM-WAS
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              FLUIDS  KEYWORDS  FLUIDS BY AERATION & FLAMELESS ATOMIC ABSORPTION SPECTROPHOTOMETRY  KEYWORDS  MERCURY PO
              LLUTANT-IDENTIFICATION FEEDS FISH CHEMICAL-ANALYSIS ACIDS CHEMICAL-REACTIONS OXIDATION FEEDS MILK-POULTRY
              REDUCTION-CHEMICAL CALIBRATIONS AERATION BIOLOGICAL-SAMPLES POTASSIUM-PERMANGANATE STANNOUS-CHLORIDE SULFU
              RIC-ACID REAGENTS BLOOD URINE MEAT EGGS ATOMIC-ABSORPTION-SPECTROPHOTOMETRY PRECISION SAMPLE-PREPARATION C
              HEMICAL-RECOVERY


100 71 1223   BRUST R A           MIYAZAKI S           HODGSON G C
              EFFECT OF DURSBAN IN THE DRINKING WATER OF CHICKS  KEYWORDS  POULTRY BLOOD DURSBAN CHOLIN-ESTERASE  WATER-
              POLLUTION-EFFECTS
              JOURNAL OF ECONOMIC ENTOMOLOGY VOL 64 NO 5 1971 P 1179-1183

100 71 1228   LOEHR R C
              ALTERNATIVES FOR THE TREATMENT AND DISPOSAL OF ANIMAL  WASTES  KEYWORDS  FARM-WASTES DISPOSAL TREATMENT SY
              STEMS-ANALYSIS RUNOFF  POLLUTANT NUTRIENTS AEROBIC-TREATMENT ANAEROBIC-DIGESTION  DENTRIFICATION NITRIFICA
              TION EFFLUENTS LEGAL-ASPECTS  WASTE-WATER-TREATMENT WASTE-DISPOSAL OPTIONS LAND-DISPOSAL  OXIDATION-DITCH
              POLLUTIONAL-CHARACTERISTICS-ALTERNATIVES  ALTERNATIVES DISPOSAL
              JOURNAL WATER POLLUTION CONTROL FEDERATION VOL 43 NO 4       P 668-678 2 TAB 2 FIG 10 REF

100 71 1232   FRITSCHI E W        MACDONALD F W
              WASTE WATER FROM SIMIAN PRIMATE FACILITIES  KEYWORDS  LABORATORY-ANIMALS WASTE-WATER-TREATMENT DESIGN-CRIT
              ERIA  SAMPLING ANALYTICAL-TECHNIQUES EVAPORATION DISINFECTION  BIOLOGICAL-OXYGEN-DEMAND URINE COLIFORMS PA
              THOGENIC-BACTERIA ANIMAL-PARASITES CHLORINATION LOUISIANA TREATMENT-FACILITIES PRIMATES BACTERIOLOGICAL-AN
              ALYSES FECES
              JOURNAL WATER POLLUTION CONTROL FEDERATION VOL 43           NO 5 MAY 1971 P 883-889

100 71 1236   CROSBY III J W      JOHNSTONE D L        FENTON R L
              MIGRATION OF POLLUTANTS IN A GLACIAL OUTWASH ENVIRONMENT  KEYWORDS  PATH-OF-POLLUTANTS GLACIAL-DRIFT FARM-
              WASTES CONFINEMENT-PENS COLIFORMS NITRATES NUTRIENTS SOLUTES SOIL-WATER-MOVEMENT  GROUNDWATER WASHINGTON W
              ATER-POLLUTION-SOURCES CHLORIDES  SOIL-MOISTURE FEEDLOT-CATTLE OUTWASH-GLACIAL
              WATER RESOURCES RESEARCH VOL 7 NO 1 FEB 1971 P 204-208       5 FIG 11 REF

100 72 0746   DUGAN G L           GOLUEKE C G          OSWALD W J
              RECYCLING SYSTEM FOR POULTRY WASTES  KEYWORD  NITROGEN LAGOON PUMPING AEROBIC BIOCHEMICAL-OXYGEN-DEMAND CH
              EMICAL-OXYGEN-DEMAND NUTRIENT  RECYCLING POULTRY
              JOUR WAT POL CONTROL FED VOL 44 NO 3 P432-440 MARCH 1972

100 72 1097   LORIMOR J C         MIELKE L N           ELLIOTT L F          ELLIS J R
              NITRATE CONCENTRATIONS IN GROUNDWATER BENEATH A BEEF CATTLE FEEDLOT  KEYWORDS  NITRATES CATTLE FEED-LOTS W
              ATER-POLLUTION IRRIGATION FARM  GROUNDWATER WATER-QUALITY AQUIFER SAMPLES NEBRASKA  WELLS 3-DAY-PUMPING-ST
              UDY TRANSMISSIVITY
              WATER RESOURCES BULLETIN VOL 8 NO 5 OCT 1972 P 999-1005      3 TAB 4 FIG 6 REF

100 72 1129   GILBERTSON C B      NIENABER J A         MCCALLA T M          ELLIS J R           WOODS W R
              BEEF CATTLE FEEDLOT RUNOFF,  SOLIDS TRANSPORT AND SETTLING CHARACTERISTICS  KEYWORDS  FEED-LOT. RUNOFF CON
              TINUOUS-FLOW FARM-WASTES CATTLE  WASTE-WATER-TREATMENT SOLIDS-REMOVAL-SYSTEMS BATCH-SYSTEM
              TRANSACTIONS OF THE AMERICAN SOCIETY OF AGRICULTURAL        ENGINEERS V 15 NO 6 1972 P 1132-1134 6 FIG 8 R
              EF

100 72 1188   BETHEA R M          NARAYAN R S
              IDENTIFICATION OF BEEF CATTLE FEEDLOT ODORS  KEYWORDS  AIR-POLLUTION ODOR CATTLE FEED-LOTS FARM WASTES-GAS
              ES  GAS-CHROMATOGRAPHY SOLUBILITY ALCOHOLS AMINES ALDEHYDES  ESTERS CARBONYLS
              TRANSACTIONS OF THE ASAE 1972 P 1135-1137 2 TAB 2 FIG       10 REF

100 72 1193   ZALL R R
              CHARACTERISTICS OF MILKING CENTER WASTE EFFLUENT FROM NEW  YORK STATE DAIRY FARMS  KEYWORDS  SEWAGE-EFFLUE
              NTS WASTE-IDENTIFICATION DAIRY-INDUSTRY CATTLE EFFLUENTS FARM-WASTES BIOCHEMICAL-OXYGEN-DEMAND  WATER-POLL
              UTION-SOURCES NUTRIENTS NITRATES NITRITES
              JOURNAL OF MILK FOOD TECHNOLOGY V 35 NO 1 1972 P 53-55       6 TAB 1 FIG 3 REF
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100 72 1199 KATZ S E FASSBENDER C A
IMPROVED PROCEDURES FOR THE DETERMINATION OF OXYTETRACYCLINE IN MILK MILK PRODUCTS CHICKEN MUSCLE LIVER AND EGGS KEYWORDS ANITBIOTICS-PESTICIDES ANALYTICAL-TECHNIQUES EVALUATION POLLUTANT-IDENTIFICATION MILK POULTRY ORGANIC-PESTICIDES METHOLOLOGY CENTYRIFUGATION BIOASSAY PESTICIDE-RESIDUES METHODOLOGY FEEDS BIOLOGICAL-SAMPLES OXYTETRACYCLINE MILK-PRODUCTS TISSUES MUSCLE LIVER EGGS DETECTION-LIMITS BIOACCUMULATION RECOVERY CHLORTETRACYLINE
BULLETIN OF ENVIROMENTAL CONTAMINATION AND TOXICOLOGY VOL 7 NO 4 APRIL 1972 P 229-236 8 TAB 6 REF

100 72 1215 HUNT L M GILBERT B N
AUTOMATED COMBUSTION VERSUS DIGESTION FOR TRITIUM MEASUREMENT IN BIOLOGICAL SAMPLES KEYWORDS DIGESTION TRITIUM AUTOMATION CHEMICAL-ANALYSIS BIOASSAY POLLUTANT-IDENTIFICATION SUSPENSION QUENCHING AQUEOUS-SOLUTIONS ANIMAL-WASTES SOLVENT-EXTRACTIONS WATER-POLLUTION-SOURCES THIOCARBAMATE-PESTICIDES SHEEP BIOLOGICAL-SAMPLES COMBUSTION FERBAM TISSUE RECOVERY LIQUID-SCINTILLATION SAMPLE-PREPARATION LUNGS PANCREAS BONE HEART BRAIN SPLEEN MUSCLE LIVER KIDNEYS FECES BLOOD
INTERNATIONAL JOURNAL OF APPLIED RADIATION AND ISOTOPES VOL 23 NO 5 MAY 1972 P 246-249 2 TAB 1 FIG 8 REF

100 72 1222 GEHRT A J
PEPSIN DIGESTIBILITY METHOD FOR ANIMAL PROTEINS KEYWORDS DIGESTION FILTRATION ANALYTICAL-TECHNIQUES PROTEIN CENTRIFUGATION POULTRY NITROGEN-COMPOUNDS ORGANIC-COMPOUNDS CHEMICAL-ANALYSIS METHODOLOGY QUALITY-CONTROL PEPSIN INTERLABORATORY-TESTS COLLABORATIVE-STUDIES BIOLOGICAL-SAMPLES METHOL-VALIDATION DATA-INTERPRETATION
JOURNAL OF THE ASSOCIATION OF OFFICIAL ANALYTICAL CHEMISTS VOL 55 NO 4 1972 P 702-706 1 TAB 4 REF

100 72 1224 EVANS M R OWENS J D
FACTORS AFFECTING THE CONCENTRATION OF FAECAL BACTERIA BACTERIA IN LAND DRAINAGE WATER KEYWORDS DRAINAGE-WATER FARM-WASTES ENVIRONMENTAL-EFFECTS SUB-SURFACE-DRAINAGE ENTERIC-BACTERIA SUBSURFACE-WATERS HOGS FLOW-RATES EQUATIONS WATER-POLLUTION-SOURCES PERCOLATION SOIL-WATER-MOVEMENT SEEPAGE POLLUTANT-IDENTIFICATION BIOCHEMICAL-OXYGEN-DEMAND E-COLI FILTRATION MEMBRANES DISCHARGE-WATER WEIR-GAUGES CLAY-LOAM SANDS SURFACE-RUNOFF ENTEROCOCCI BIOCHEMICAL-TESTS FECAL-COLIFORMS
JOURNAL OF GENERAL MICROBIOLOGY VOL 71 NO 3 AUG 1972 P 477-485 4 FIG 8 REF

100 72 1235 MCGHEE T J TORRENS R L SMAUS R J
BOD DETERMINATIONS ON FEEDLOT RUNOFF KEYWORDS ANALYTICAL-TECHNIQUES BIOCHEMICAL-OXYGEN-DEMAND POLLUTANT-IDENTIFICATION CATTLE ORGANIC-METTER CHEMICAL-OXYGEN-DEMAND OXYGEN-DEMAND FEED-LOTS FARM-WASTES CATTLE-FEEDLOT-RUNOFF ULTIMATE-BOD
WATER AND SEWAGE WORKS VOL 119 NO 6 JUNE 1972 P 58-61 1 TAB 7 FIG 20 REF

100 73 1034 HAMILTON H E ROSS I J JACKSON S W
TECHNIQUES FOR SAMPLING AND HANDLING OF ANAEROBIC MICROBES IN WASTE FERMENTATION SYSTEMS KEYWORDS AUTOCLAVES FARM-WASTES POULTRY LIVESTOCK ANAEROBIC-CONDITIONS FERMENTATION ANALYTICAL-TECHNIQUES DILUTION RUMEN-SAMPLING FERMENTOR-SAMPLING TEST-TUBES PIPETTING-DEVICE INOCULATION MICROBIAL-GROWTH COLONY-COUNTING CHEMICAL-CHANGES
TRANSACTIONS OF ASAE VOL 16 NO 1 1973 P 172-175 9 FIG 4 REF

100 73 1069 BERRYMAN C HATEY T CALDWELL T H BODY D A
MANURING OF POTATOES ON PEN SILT SOILS IN HOLLAND LINCOLNSHIRE KEYWORDS SILTS FERTILIZERS POTATOES NITROGEN PHOSPHORUS POTASSIUM ENGLAND NUTRIENTS DRAINAGE FARM-WASTES WASTE-DISPOSAL SOIL-PROFILES TUBER-BLACKENING
JOURNAL OF AGRICULTURAL SCIENCE VOL 80 APRIL 1973 P 269-281 12 TAB 1 FIG 17 REF

100 73 1086 LITTLEFIELD L H BLETNER J K GOFF O E
THE EFFECT OF FEEDING LAYING HENS VARIOUS LEVELS OF COW MANURE ON THE PIGMENTATION OF EGG YOLKS KEYWORDS RECYCLING CATTLE FARM-WASTES POULTRY DIETS BLOOD-XANTHOPHYLL-LEVELS YOLK-PIGMENTATIONS BLOOD
POULTRY SCIENCE VOL 52 NO 1 JAN 1973 P 179-181 3 TAB 10 REF

100 73 1087 LUEBS R E DAVIS K R LAAG A E
ENRICHMENT OF THE ATMOSPHERE WITH NITROGEN COMPOUNDS VOLATILIZED FROM A LARGE DAIRY AREA KEYWORDS DAIRY-INDUSTRY CATTLE NITROGEN AMMONIA AIR-POLLUTION FEED-LOTS WATER-POLLUTION TOXICITY FARM-WASTES SAMPLING TEMPERATURE HUMIDITY WINDS RAINFALL DISTILLABLE-NITROGEN NONDISTILLABLE-NITROGEN ATMOSPHERIC-NH3
JOURNAL OF ENVIRONMENTAL QUALITY VOL 2 NO 1 JAN-MARCH 1973 P 13[illegible] [illegible] TAB 3 FIG 18 REF

100 73 1088 ROBINSON J J SCOTT D FRASER C
OBSERVATIONS ON THE EFFECT OF PROTEIN INTAKE AND STAGE OF GESTATION ON THE PROPORTION OF URINARY NITROGEN EXCRETED AS UREA IN SHEEP KEYWORDS SHEEP DIETS ENERGY PROTEIN-INTAKE GESTATION URINARY-NITROGEN NITROGEN-RETENTION
THE JOURNAL OF AGRICULTURAL SCIENCE VOL 80 NO 3 JUNE 1973 P 363-368 3 TAB 4 FIG 14 REF

100 73 1128 CULLEY D D JR EPPS E A
USE OF DUCKWEED FOR WASTE TREATMENT AND ANIMAL FEED KEYWORDS FARM-WASTES WASTE-WATER-TREATMENT FARM-LAGOONS NUTRIENT-REMOVAL FEEDS LIVESTOCK DUCKWEED LEMNACEAE
JOURNAL WATER POLLUTION CONTROL FEDERATION V 45 NO 2 FEB 1973 P 337-347 5 TAB 1 FIG 28 REF

100 73 1155 HECKER J F
THE FATE OF SOLUBLE MUCIN IN THE GASTRO INTESTINAL TRACT OF SHEEP KEYWORDS NITROGEN SHEEP ENZYMES HYDROLYSIS SOLUBLE-MUCINS TCA-SOLUBLE-MUCIN RUMEN-LIQUOR FAECEL-LIQUOR GASTRO-INTESTINAL-TRACTS FUCOSE RHAMNOSE HEXOSE METHYL-PENTOSE HISTOLOGY
JOURNAL OF AGRICULTURAL SCIENCE V 80 1973 P 63-69 4 TAB 40 REF

100 73 1162 ABBOTT J L TUCKER T C
PERSISTENCE OF MANURE PHOSPHORUS AVAILABILITY IN CALCAREOUS SOIL KEYWORDS FERTILITY WASTE-DISPOSAL PHOSPHORUS NITROGEN CALCAREOUS-SOILS COTTON BARLEY ALFALFA ARIZONA CYCLING-NUTRIENTS PLANT-NUTRITION POLLUTION-CONTROL
SOIL SCIENCE SOCIETY OF AMERICA PROCEEDINGS V 37 NO 1 JAN FEB 1973 P 60-63 5 TAB 1 FIG 11 REF

100 73 1164 COX N A DAVIS B H WATTS A B COLMER A R
SALMONELLA IN THE LAYING HEN I SALMONELLA RECOVERY FROM VISCERA FECES AND EGGS FOLLOWING ORAL INOCULATION KEYWORDS SALMONELLA FARM-WASTES POULTRY BACTERIA DISEASES ANALYSIS TISSUES CONTAMINATION EGGS INOCULATION SEFTENBERG THOMPSON TYPHIMURIUM
POULTRY SCIENCE V 52 NO 2 MAR 1973 P 661-666 3 TAB 21 REF

100 73 1165 SHERMAN M HERRICK R B
FLY CONTROL AND CHRONIC TOXICITY FROM FEEDING DURSBAN 0-0 DIETHYL 0-3 5 6-TRICHLORO-2-PYRICYL PHOSPHOROTHIOATE TO LAYING HENS KEYWORDS PESTICIDE-TOXICITY FARM-WASTES POULTRY LARVAE FEEDS ADDITIVES DURSBAN FLY-CONTROL
POULTRY SCIENCE V 52 NO 2 MAR 1973 P 741-747 3 TAB 3 FIG 12 REF

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100 73 1184   DUGAN G L            YOUNG R H F          TAKAMIYA G
              ANIMAL WASTE MANAGEMENT IN HAWAII  KEYWORDS  FARM-WASTES LIVESTOCK WASTE-DISPOSAL WASTE-TREATMENT  AIR-POL
              LUTION WATER-POLLUTION GROUNDWATER-POLLUTION  WASTE-WATER-TREATMENT BIOCHEMICAL-OXYGEN-DEMAND NITROGEN  PO
              NDS DRYING INCINERATION RECYCLING HAWAII  SUBTROPICAL-ENVIRONMENT LAND-SPREADING COMPOSTING
              JOURNAL WATER POLLUTION CONTROL FEDERATION V 45 NO 4        APR 1973 P 742-750 4 TAB 1 FIG 22 REF

100 73 1190   CHICCO C F           AMMERMAN C B         FEASTER J P          DUNAVANT B G
              NUTRITIONAL INTERRELATIONSHIPS OF DIETARY CALCUIM  PHOSPHORUS AND MAGNESUIM IN SHEEP  KEYWORDS  CALCUIM PH
              OSPHORUS MAGNESUIM SHEEP METABOLISM  NUTRITIONAL-INTERRELATIONSHIPS PLASMA FECAL-EXCRETION  BASAL-DIET FEM
              UR-DEPOSITION
              JOURNAL OF ANIMAL SCIENCE V 36 NO 5 MAY 1973 P 986-993      6 TAB 1 FIG 28 REF

100 73 1263   CROSS D L            BOLING J A           BRADLEY N W
              CHROMIC OXIDE AND CRUDE PRUTEIN EXCRETION IN THE BOVINE AS  INFLUENCED BY WATER RESTRICTION  KEYWORDS  FAR
              M-WASTES PROTEINS CATTLE METABOLISM CHROMIC-OXIDE WATER-RESTRICTION DRY-MATTER-DISPESTIBILITY FECAL-DRY-MA
              TTER
              JOURNAL OF ANIMAL SCIENCE VOL 36 NO 5 MAY 1973 P 982-985    4 TAB 2 FIG 12 REF

100 70 1237   LIAO P B


              POLLUTION POTENTIAL OF SALMONID FISH HATCHERIES


              KEYWORDS  WATER-POLLUTION-SOURCES FISH-HATCHERIES SALMONIDS
              WATER-REQUIREMENTS TEMPERATURE NUTRIENTS ALGAE WEEDS TASTE  ODOR PATHOGENIC-BACTERIA ORGANIC-WASTES SOLID-
              WASTES CHEMICALS MICHIGAN CALIFORNIA TUBIFICIDS COLORADO WATER-POLLUTION-CONTROL WASHINGTON CHEMICAL-OXYGE
              N-DEMAND DISSOLVED-OXYGEN HYDROGEN-ION-CONCENTRATION AMMONIA NITRATES PHOSPHATES SUSPENDED-LOAD DISSOLVED-
              SOLIDS EFFLUENTS SETTLEABLE-SOLIDS HATCHERY-EFFLUENTS PARASITES JORDAN-RIVER-MICH SAN-JOAQUIN-RIVER-CA
              WATER AND SEWAGE WORKS VOL 117 NO 8 1970 P 291-297 3 TAB    6 FIG 15 REF

200 64 0750   DORNBUSH J N         ANDERSEN J R
              LAGOONING OF LIVESTOCK WASTES IN SOUTH DAKOTA  KEYWORD  ANAEROBIC AEROBIC POULTRY CONFINEMENT BIOCHEMICAL-
              OXYGEN-DEMAND CHEMICAL-OXYGEN-DEMAND AMMONIA NITROGEN SOUTH-DAKOTA  LAGOON
              PROC 19TH IND WASTE CONF PART 1 PP317-325 1964

200 64 0759   MAYES J L            SMITH S M            MINER J R
              STREAM POLLUTION FROM FEEDLOT RUNOFF  KEYWORD  KANSAS BIOCHEMICAL-OXYGEN-DEMAND CHEMICAL-OXYGEN-DEMAND AMM
              ONIA NITROGEN FISH CATTLE  FEEDLOT RUNOFF
              PROC 14TH ANNUAL CONF SANITARY ENGR U KANSAS LAWRENCE 24PP  JAN 1964

200 64 1240   CLARK H F            KABLER P W
              THE PHYSIOLOGY OF THE COLIFORM GROUP  KEYWORDS  BACTERIA COLIFORMS POLLUTANTS SANITARY-ENGINEERING WATER F
              OODS SOILS GASES HYDROGEN CARBON-DIOXIDE FERMENTATION  PLANTS CATTLE GRAINS-CROPS BIOCHEMISTRY MICRO-ORGAN
              ISMS  MILK ACID-BACTERIA CARBOHYDRATES PHYSIOCHEMICAL-PROPERTIES  ANIMALS STATISTICAL-METHODS BIRDS HUMAN-
              DISEASES SHEEP GEOGRAPHICAL-REGIONS UNITED-STATES INSPECTION SPORES HYDROGEN-SULFIDE E-COLI PHYSIOLOGY BAC
              ILLUS-COLI TAXONOMY HEALTH AEROBACTER-AEROGENES FECES GLUCOSE MORPHOLOGY BACTERIUM-COLI BACTER
              PROCEEDINGS OF AUDOLFS RESEARCH CONFERENCE PRINCIPLES & APPLICATIONS IN AQUATIC MICROBIOLOGY
                        JOHN WILEY AND SONS INC RUTGERS UNIV NEW BRUNSWICK N J 1964 P 202-229 2 TAB 1 FIG 52 REF

200 64 1241   GUTIERREZ J          DAVIS R E
              PHYSIOLOGY OF THE RUMEN PROTOZOA  KEYWORDS  RUMINANTS PROTOZOA BACTERIA CATTLE REPRODUCTION METABOLISM  AM
              INO-ACIDS TRACERS PROTEINS CHROMATOGRAPHY FERMENTATION  DIGESTION LIPIDS MANOMETERS STREPTOCOCCUS ALFALFA
              RUMEN  PHYSIOLOGY CASEIN ISOTRICHS HOLOTRICHS PARAMECIUM  ISOTRICHA-PROSTOMA ISOTRICHA-INTESTINALIS DASYTR
              ICHA DIPLODINIUM-ECAUDATUM ENTODINIUM-SIMPLEX OPHRYOSCOLEX-CAUDATUS STARCH  EPIDINIUM-ECAUDATUM DIPLOCOCCU
              S PEPTOSTREPTOCOCCUS
              PROCEZDINGS OF RUDOLFS RESEARCH CONFERENCE                  PRINCIPLES AND APPLICATIONS IN AQUATIC MICROBI
              OLOGY JOHN    WILEY AND SONS INC RUTGERS UNIV NEW BRUNSWICK N J 1964      P 394-404 1 TAB 2 FIG 17 REF.

200 66 0115   ASAE  SPONSOR
              MANAGEMENT OF FARM ANIMAL WASTES  KEYWORDS  ECONOMICS BOD  COD SLURRIES DISPOSAL ODOR STORAGE CATTLE SWINE
               POULTRY FEED IRRIGATION FEEDLOT PRODUCTION PROPERTIES STORAGE HEALTH  POLLUTION LABOR ENVIRONMENT RUNOFF
              EQUIPMENT OXIDATION-DITCH COMPOSTING COPROPHAGY NITROGEN TREATMENT SYSTEMS CONFINMENT MANAGEMENT
              PROC NAT SYMP ANIMAL WASTE MGMT, ASAE SP-0366, 1-160,1966

200 66 0116   WITZEL S A           MCCOY E              POLKOWSKI L B        ATTOE O J            NICHOLS M S
              PHYSICAL, CHEMICAL AND BACTERIOLOGICAL PROPERTIES OF FARM  WASTES  BOVINE ANIMALS  KEYWORDS  LAGOON-FLORA
              AEROBIC  AEROBIC PLANT-RESPONSE BOD COD  PROPERTIES
              PROC NAT SYMP ANIMAL WASTE MGMT, ASAE SP-0366, 10-14,1966

200 66 0117   MORRIS G L
              DUCK-PROCESSING WASTE  KEYWORDS  POULTRY DUCKS BOD COLIFORMS LONG-ISLAND PROCESSING-PLANTS WASTE-LOADS
              PROC NAT SYMP ANIMAL WASTE MGMT, ASAE SP-0366, 15-18,1966

200 66 0118   DECKER W M           STEELE J H
              HEALTH ASPECTS AND VECTOR CONTROL ASSOCIATED WITH ANIMAL  WASTES  KEYWORDS  PUBLIC-HEALTH DISEASES PATHOGE
              NIC-ORGANISM WATER-POLLUTION SALMONELLOSIS  HEALTH VECTOR
              PROC NAT SYMP ANIMAL WASTE MGMT, ASAE SP-0366, 18-20,1966

200 66 0119   ANDERSON J R
              BIOLOGICAL INTERRELATIONSHIPS BETWEEN FECES AND FLIES  KEYWORDS  FILTH-FLIES CONFINEMENT PRODUCTION MODELS
               FLIES
              PROC NAT SYMP ANIMAL WASTE MGMT, ASAE SP-0366, 20-23,1966

200 66 0120   MINER J R            FINA L R             FUNK J H             LIPPER R I           LARSON G H
              STORMWATER RUNOFF FROM CATTLE FEEDLOTS  KEYWORDS  STORAGE  NITROGEN ORGANIC-WASTE RAINFALL COLIFORMS KJELD
              AHL-NITROGEN BACTERIA SLUGGING WATER-POLLUTION  RUNOFF CATTLE FEEDLOTS
              PROC NAT SYMP ANIMAL WASTE MGMT, ASAE SP-0366, 23-27,1966

200 66 0121   SOBEL A T
              PHYSICAL PROPERTIES OF ANIMAL MANURES ASSOCIATED WITH  HANDLING  KEYWORDS  PHYSICAL-PROPERTIES LIQUID-WAST
              E POULTRY CATTLE FREEZING-POINT VS FLOWABILITY PRODUCTION  PROPERTIES
              PROC NAT SYMP ANIMAL WASTE MGMT, ASAE SP-0366, 27-32,1966
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200 66 0122 OSTRANDER C E
METHODS OF HANDLING POULTRY-WASTE MATERIAL KEYWORDS OUOR POULTRY WASTE-STORAGE DISPOSAL CONFINEMENT HANDLING PUMPS METHOD
PROC NAT SYMP ANIMAL WASTE MGMT, ASAE SP-0366, 32-33,1966

200 66 0123 HART S A MOORE J A HALE W F
PUMPING MANURE SLURRIES KEYWORDS PUMPS SLURRIES CAPACITY EFFICIENCIES HANDLING SELECTION-CRITERIA
PROC NAT SYMP ANIMAL WASTE MGMT, ASAE SP-0366, 34-38,1966

200 66 0124 MYERS E A
ENGINEERING PROBLEMS IN YEAR-ROUND DISTRIBUTION OF WASTE WATER KEYWORDS SPRINKLING DISTRIBUTION FREEZING DISPUSAL PENN-STATE IRRIGATION-HEADS PROBLEM
PROC NAT SYMP ANIMAL WASTE MGMT, ASAE SP-0366, 38-41,1966

200 66 0125 MORRISON S R MENDEL V E BOND T E
SLOPING FLOORS FOR BEEF-CATTLE FEEDLOTS KEYWORDS DISPOSAL CONFINEMENT SLATTED-FLOORS BEHAVIOR FEED-EFFICIENCY GAINS FEEDLOT
PROC NAT SYMP ANIMAL WASTE MGMT, ASAE SP-0366, 41-43,1966

200 66 0126 SCHMISSEUR W E BROWN C M JR ALBRIGHT J L DILLON W M DALE A C
MATERIALS HANDLING AND LABOR IN FREE-STALL AND LOOSE HOUSING KEYWORDS CATTLE CONFINEMENT DISPOSAL BEDDING LABOR
PROC NAT SYMP ANIMAL WASTE MGMT, ASAE SP-0366, 43-45,1966

200 66 0127 DAVIS E H
CATTLE-MANURE HANDLING AND DISPOSAL SYSTEMS ON THE WEST COAST KEYWORDS CATTLE LOADING SHEDS MANAGEMENT SANITATION HEALTH-AUTHORITIES CLIMATIC-CONDITIONS ALLEYWAYS DISPOSAL
PROC NAT SYMP ANIMAL WASTE MGMT, ASAE SP-0366, 45-47,1966

200 66 0128 MUORE J A FAIRBANK W C
MACERATION FOR DISPOSAL OF DEAD POULTRY KEYWORDS DISPOSAL LAGOONS SEPTIC-TANKS EQUIPMENT SLURRIES COMPOSTING
PROC NAT SYMP ANIMAL WASTE MGMT, ASAE SP-0366, 47-49,1966

200 66 0129 QUISENBERRY J H MALIK D D IBARBIA R
WATER METABOLISM STUDIES MAY ASSIST WITH WASTE DISPOSAL KEYWORDS POULTRY ODOR CLAYS CONFINEMENT DIETS LAYING-BIRDS GENETICS EXCRETION EGGS DISPOSAL
PROC NAT SYMP ANIMAL WASTE MGMT, ASAE SP-0366, 49-51,1966

200 66 0130 REED C H
DISPOSAL OF POULTRY MANURE BY PLOW-FURROW-COVER KEYWORDS ODOR SLURRIES FURROWS FLIES LIQUID-MANURE MANAGEMENT PLOW DISPOSAL POULTRY
PROC NAT SYMP ANIMAL WASTE MGMT, ASAE SP-0366, 52-53,1966

200 66 0131 JONES J H TAYLOR G S
DISPOSAL OF HOUSEHOLD WASTES IN THE SOIL KEYWORDS SEWERS SEPTIC-TANKS ABSORPTION SOIL-CLOGGING RURAL-AREAS CONSTRUCT DISPOSAL
PROC NAT SYMP ANIMAL WASTE MGMT, ASAE SP-0366, 53-55,1966

200 66 0132 BERRY E C
REQUIREMENTS FOR MICROBIAL REDUCTION OF FARM ANIMAL WASTES KEYWORDS LAGOONS ODOR BIODEGRADATION BACTERIA PHAGE FUNGI CHEMICAL-ENVIRONMENT PHYSICAL-ENVIRONMENT INOCULATION REQUIREMENTS
PROC NAT SYMP ANIMAL WASTE MGMT, ASAE SP-0366, 56-58,1966

200 66 0133 IRGENS R L DAY D L
AEROBIC TREATMENT OF SWINE WASTE KEYWORDS SLOTTED-FLOOR AERATION BOD COD COLLECTION PITS OXIDATION OXIDATION-DITCH TREATMENT SWINE
PROC NAT SYMP ANIMAL WASTE MGMT, ASAE SP-0366, 58-60, 1966

200 66 0134 WEBSTER N W CLAYTON J T
OPERATING CHARACTERISTICS OF TWO AEROBIC-ANAEROBIC DAIRY MANURE TREATMENT SYSTEMS KEYWORDS AERATION SEDIMENTATION VOLATILE SOLIDS DISSOLVED OXYGEN BOD CHARACTERISTICS DAIRY
PROC NAT SYMP ANIMAL WASTE MGMT, ASAE SP-0366, 61-65, 1966

200 66 0135 BRIDGHAM D O CLAYTON J T
TRICKLING FILTERS AS A DAIRY-MANURE STABILIZATION COMPONENT KEYWORDS BOD LABORATORY TEST RECIRCULATED-WATER EFFLUENTS SEDIMENTATION SLUDGE VOLATILE-SOLIDS LOADING-RATE BACTERIA TRICKLING-FILTERS DAIRY-MANURE
PROC NAT SYMP ANIMAL WASTE MGMT, ASAE SP-0366, 66-68,1966

200 66 0136 HOWES J R
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200 66 0138 CURTIS D R
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200 66 0141 CAUSS D E
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200 66 0143 SUBEL A T LUDINGTON D C
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200 66 0146 ANTHONY W B
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200 66 0147 DURHAM R M
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ERS KEYWORDS NUTRIENTS LAGOON NUTRIENTS GRASSES FERTILIZER EFFLUENTS EVALUATING FILTERS
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OCATION MANURE LEGAL ASPECTS ODOR METROPOLITAN-AREAS PROBLEM ARIZONA
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200 66 0152 MORRIS W H M
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200 66 0154 ALLRED E R
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ITROGEN FERTILIZER CATTLE URINE DISPOSAL GERMANY PLANT
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              OKLAHOMA CATTLE FEEDERS SEMINAR STILLWATER FEB 2-3 1967     P 1-9

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              SOURCES CATTLE FISHKILL WASTE-DISPOSAL KANSAS RUNOFF NITROGEN-DRAINAGE DISEASES  WATER-POLLUTION-EFFECTS A
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200 68 0434   OWENS T R           GRIFFIN W L
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200 68 0694   PROCTOR D E
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              MENTS DISPOSAL
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              -PENS RECYCLE CONTROL MANURE
              PROC 8TH IND WATER WASTEWATER CONF LUBBOCK TEX P59 JUNE     1968

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              PERATURE ENVIRONMENTAL-CONTROL SLOTTED-FLOOR  EFFECTS
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200 68 1187   PROCTOR D E
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200 68 1242   KRONE R B
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200 68 1244   DUNLOP S G
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              CIPAL-WASTES  PATHOGENIC-BACTERIA VIRUSES PARASITISM WASTE-TREATMENT  ENVIROMENTAL-SANITATION WASTE-WATER-
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200 69 0055   TAIGANIDES E P
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200 69 0074   JONES D D           CONVERSE J C        DAY D L
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200 69 0078   JONES D D           DAY D L             CONVERSE J C
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              NT OXIDATION-DITCH ALPHA-FACTOR ODOR MASS-TRANSFER THEORETICAL-ANALYSIS  CONFINEMENT
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200 69 0158 WEINBERGER L W
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200 69 0159 KING D R
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200 69 0160 BERNARD H
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200 69 0161 LOEHR R C
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200 69 0162 JONES P H
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200 69 0163 VICKERS A F GENETELLI E J
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200 69 0164 SCHMID L A LIPPER R I
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200 69 0165 WELLS D M ALBIN R C GRUB W WHEATON R Z
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200 69 0166 KOLEGA J J NELSON G L GRAVES Q B
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200 69 0167 BLOODGOOD D E ROBSON C M
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200 69 0168 CLAYTON J T FENG T H
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200 69 0171 ANTHONY W B
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200 69 0172 REED C H
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200 69 0173 MILLER B F LINDSAY W L PARSO A A
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200 69 0174 WEBBER L R LANE T H
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200 69 0177   JONES D D            DAY D L              CONVERSE J C
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200 69 0178   MOORE J A            LARSON R E           ALLRED E R
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200 69 0179   EDWARDS J B          ROBINSON J B
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                NITRIFICATION DENITRIFICATION REDOX-POTENTIAL ROTORS OXIDATION-DITCH  POULTRY
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200 69 0180   FOREE G R            O DELL R A
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200 69 0181   RADEMACHER J M       RESNIK A V
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              ALITY-ACT RESEARCH REGULATION  FEEDLOT
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200 69 0182   NORTON T E           HANSEN R W
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200 69 0183   GRUB W               ALBIN R C            WELLS D M            WHEATON R Z
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              S  BOD  NITROGEN PHOSPHORUS RUNOFF RATION FEEDLOT-LAYOUT  EFFECT DESIGN MANAGEMENT CONTROL
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200 69 0186   LASALLE R M JR       LAUNDER M
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200 69 0187   WALKER J P           POS J
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              C AEROBIC BOD MORTALITY FEED-CONVERSION AERATOR POPULATION-EQUIVALENT  LAYER OXIDATION-DITCHES STORAGE
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200 69 0188   MEEK A M             MERRILL W G          PIERCE R A
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              GE ODOR SLATTED-FLOORS POISONOUS-GASES AGITATION FREE-STALL-HOUSING  PROBLEMS PRACTICES
              ANIMAL WASTE MANAGEMENT 1969 254-259                        CORNELL UNIV CONF ON AGR WASTE MGMT

200 69 0189   SOBEL A T
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              ANIMAL WASTE MANAGEMENT 1969 260-270                        CORNELL UNIV CONF ON AGR WASTE MGMT

200 69 0190   BURNETT W E          DONDERO N C
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              KEYWORDS  ODOR-PANEL AEROBIC-BACTERIA ANAEROBIC-BACTERIA AMMONIA HYDROGEN-SULFIDE SULFUR-BACTERIA URIC-ACI
              D OLFACTORY-THRESHOLD-TEST  ODOR-INTENSITY-INDEX THRESHOLD-ODOR-NUMBERS
              ANIMAL WASTE MANAGEMENT 1969 271-291                        CORNELL UNIV CONF ON AGR WASTE MGMT

200 69 0191   GUMERMAN R C         CARLSON P A
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              R DETENTION-TIME REMOVAL-MECHANISM REACTION-TEMPERATURE  REMOVAL
              ANIMAL WASTE MANAGEMENT 1969 292-302                        CORNELL UNIV CONF ON AGR WASTE MGMT

200 69 0192   EBY H J              WILLSON G B
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              Y DUST ODOR REMOVAL
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200 69 0193 WARD J C JEX E M
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200 69 0200 LINTON R E
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200 69 0202 CASLER G L
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ANIMAL WASTE MANAGEMENT 1969 401-406 CORNELL UNIV CONF ON AGR WASTE MGMT

200 69 0203 ALLEE D J CLAVEL P
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              TE
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              SOIL FILTRATION TO REMOVE ODORS  KEYWORDS  POULTRY ORGANIC- COMPOUNDS AMMONIA HYDROGEN-SULFIDE SOIL-COLUMN
              S  ODORS
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              ODOR CONTROLS BY CHEMICAL TREATMENT  KEYWORDS  POULTRY AMMONIA-HYDROGEN-SULFIDE CARBON-DIOXIDE CHLORINE  O
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               NITROGEN  KEYWORDS  NITRIFICATION SOIL-NITROGEN PUBLIC-HEALTH SOIL-LEACHING  GROUNDWATER SOIL-PROFILES WA
              TER-TABLE SURFACE-RUNOFF  FARM-WASTES AEROBIC-CONDITIONS INCUBATION LAKE-EUTROPHICATION SOIL-PHOSPHORUS AL
              FALFA-BROMEGRASS SPRING-THAWS  FERTILIZER-NITROGEN
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              TE-DISPOSAL WATER-QUALITY WATER-QUALITY-CONTROL  WASTES INDUSTRIAL-WASTES REFUSE SEWAGE-DISPOSAL STREAMS
              RIVERS PUBLIC-HEALTH ADMINISTRATIVE-AGENCIES SEWAGE-EFFLUENTS GASOLINE OIL-WASTES FARM-WASTES CATTLE SHEEP
                HOGS
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              NT-PENS WATER-POLLUTION-SOURCES CATTLE TREATMENT-FACILITIES WATER-POLLUTION WASTE-DISPOSAL WASTE-WATER-TRE
              ATMENT WATER-POLLUTION-CONTROL REGULATION PERMITS STATE-GOVERNMENTS ADMINISTRATIVE-AGENCIES LEGISLATION LE
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              ER-SOURCES INDUSTRIAL-WASTES FARM-WASTES SEWAGE WASTE-DISPOSAL WASTE-TREATMENT WATER-USERS WATER-QUALITY S
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              ER-TABLE SURFACE-RUNOFF FARM-WASTES AEROBIC-CONDITIONS INCUBATION LAKE-EUTROPHICATION SOIL-PHOSPHORUS ALFA
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              ANIMAL WASTE DISPOSAL PROBLEMS AND TRENDS IN MINNESOTA  KEYWORDS  LIVESTOCK WASTES FARM-WASTES ORGANIC-WAS
              TES MINNESOTA BIOCHEMICAL-OXYGEN-DEMAND FARMS POLLUTANTS WATER-POLLUTION-SOURCES EUTROPHICATION LIVESTOCK-
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300 71 0538 WELLS D M ALBIN R C GRUB W COLEMAN E A MEENAGHAN G F
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NG ECONOMICS POULTRY
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POULTRY POL RESEARCH REP 152 FARM SCI MICH ST UNIV NOV 71 P8-11

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POULTRY POL RESEARCH REP 152 FARM SCI MICH ST UNIV NOV 71 P32-44

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THE EFFECTS OF CONTINUALLY RECYCLING DEHYDRATED POULTRY WASTES DPW ON THE PERFORMANCE OF SCWL LAYING HENS-A PRELIMINARY REPORT KEYWORDS NUTRIENT DEHYDRATED-FECES EFFECTS POULTRY
POULTRY POL RESEARCH REP 152 FARM SCI MICH ST UNIV NOV 71 P45-48

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A COMPILATION OF SOME SAMPLES OF DRIED POULTRY WASTE ANALYZED BY DR E J BENNE KEYWORDS PROTEIN DEHYDRATION CALCIUM PHOSPHORUS MOISTURE-CONTENT POULTRY
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AGR WASTE MGMT ASSOC ODOR CONTROL SEPT 71 CORNELL UNIV P1-6 FINAL RPT ARS-USDA COOP AGMT 12-14-100-9767 42 AWM 71-04

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AGR WASTE MGMT ASSOC ODOR CONTROL SEPT 71 CORNELL UNIV 21PP FINAL RPT ARS-USDA COOP AGMT 12-14-100-9767 42 AWM 71-04

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ROLE OF ANIMAL WASTES IN AGRICULTURAL LAND RUNOFF KEYWORD WATER-POLLUTION FARM-LAGOONS WASTE-DISPOSAL SAMPLING ANALYSIS DISPOSAL RUNOFF
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LIVESTOCK WASTE DISPOSAL AND WATER POLLUTION CONTROL KEYWORD FEED-LOTS CATTLE RUNOFF ODOR LAGOON SETTLING-BASIN NITROGEN PHOSPHORUS POTASSIUM COLORADO ANAEROBIC-LAGOON DISPOSAL CONTROL
BULL 480A COOP EXTENSION SERVICE COLORADO STATE U 13P OCT 71

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PLANNING ANIMAL WASTE DISPOSAL SYSTEMS KEYWORDS REGULATION ECONOMICS GOVERNMENT AGENCIES COSTS LEGAL-ASPECTS ODORS SYSTEMS
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CLOSED SYSTEMS FOR ANIMAL SEWAGE TREATMENT KEYWORD ENVIRONMENTAL-EFFECTS DAIRY-INDUSTRY AEROBIC-TREATMENT SOIL-TREATMENT SOLID-WASTES EFFLUENTS TERTIARY-TREATMENT TRICKLING-FILTERS ENTERIC-BACTERIA FLOW-CHARACTERISTICS NITROGEN SYSTEMS
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              ANIMAL SLAUGHTERING AND PROCESSING  KEYWORDS  REGULATIONS BY-PRODUCTS SOLID-WASTES INDUSTRIAL-WASTES WASTE
              WATER
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              ANIMAL WASTES  KEYWORDS  INDUSTRIAL-WASTES FLOW-CONTROL  TERRACES BY-PRODUCTS RENDERING ANIMAL-PROCESSING-
              WASTES
              NAT IND POL CONTROL COUNCIL STAFF REP FEB 71 15P

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              ROLE OF THE SOIL CONSERVATION SERVICE IN DESIGN OF FEEDLOT WASTE MANAGEMENT FACILITIES  KEYWORD  DESIGN-CR
              ITERIA CONSTRUCTION-COSTS COST-SHARING STANDARDS RUNOFF GOVERNMENT-SUPPORT
              USDA SOIL CONS SERVICE LINCOLN NEB 2P 1971

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              ANIMAL WASTE DISPOSAL AND CONTROL OF FEEDLOT RUNOFF  KEYWORDS  FEED-LOTS WASTE-DISPOSAL RUNOFF WATER-POLLU
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              NITRATES NEBRASKA
              COOPERATIVE EFFORT OF NORTHERN PLAINS BRANCH SOIL AND WATER CONSERVATION RESEARCH DIVISION ARS USDA AND TH
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              IMPLICATIONS OF CROP-PRODUCTION TECHNOLOGY FOR ENVIRONMENTAL QUALITY  KEYWORDS  AGRICULTURE ENVIRONMENT FA
              RM-WASTES CROP-PRODUCTION  FARM-MANAGEMENT CROP-PRODUCTION-TECHNOLOGY  ENVIRONMENTAL-QUALITY
              ENVIRONMENTAL GEOLOGY NOTES ILLINOIS STATE GEOLOGICAL       SURVEY NO 46 MAY 1971 P 7-24 6 TAB 8 FIG

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              ANNUAL REPORT OF ACTIVITIES DURING FISCAL YEAR 1971  KEYWORDS  WATER-RESOURCES WATER-USERS PLANNING PROJEC
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              EN-DEMAND DISSOLVED-OXYGEN  MANAGEMENT LIVESTOCK-WASTES WATER-QUALITY EDUCATION  EUTROPHICATION PHOSPHATES
               WATER-POLLUTION-CONTROL CHLORINATEE-HYDROCARBON-PESTICIDES MODEL-STUDIES TUBIFICIDS PHYSICOCHEMICAL-PROPE
              RTIES GASES POLITICAL-ASPECTS ATTITUDES ENVIRONM
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              AN ANALYSIS OF THE ECONOMIC IMPLICATIONS OF THE PERMIT  SYSTEM OF WATER ALLOCATION  KEYWORDS  PERMIT-SYSTE
              M ECONOMIC-EFFICIENCY WATER-QUALITY WATER-RESOURCE-INVESTMENT IOWA MODEL-STUDIES COST-ANALYSIS WATER-ALLOC
              ATION-POLICY COMPETING-USES LEGAL-ASPECTS LINEAR-PROGRAMMING  COST-ALLOCATION EVALUATION
              COMPLETION REPORT ISWRRI-43 IOWA WATER RESOURCES RESEARCH   INSTITUTE AMES NOV 1971 261 P 27 TAB 7 FIG 122
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300 71 1057   CROSS F B            CAVIN L M
              EFFECTS OF POLLUTION ESPECIALLY FROM FEEDLOTS ON FISHES IN  THE UPPER NEOSHO RIVER BASIN  KEYWORDS  FISHKI
              LL WATER-POLLUTION-EFFECTS SAMPLING HABITATS FEEDLOT-POLLUTION UPPER-NEOSHO-RIVER-BASIN NOCOMIS-ASPER NOTR
              OPIS-RUBELLUS NOTURUS-NOCTURNUS NOTORUS-PLACIDUS NOTROPIS-LUTRENSIS NOTROPIS-CAMURUS
              COMPLETION REPORT OWRR A-026-KAN1 1971 50 P 7 TAB 6 FIG     16 REF

300 71 1058   JOHNSON J D          STRAUB C P
              DEVELOPMENT OF A MATHEMETICAL MODEL TO PREDICT THE ROLE OF  SURFACE RUNOFF AND GROUNDWATER FLOW IN OVERFER
              TILIZATION OF SURFACE WATERS  KEYWORDS  MATHEMATICAL-MODELS WATERSHEDS-BASINS NUTRIENTS NITROGEN  PHOSPHOR
              US STREAMFLOW SEWAGE-TREATMENT EFFLUENTS ANNUAL-WASTES FERTILIZERS PRECIPITATION-ATMOSPHERIC SOILS WATER-P
              OLLUTION-SOURCES MODEL-STUDIES MINNESOTA SNOWMELT TREATMENT-FACILITIES NITROGEN-FIXATION DENITRIFICATION
              WRRC BULLETIN 35 OWRR PROJECT B-012-MINN1 MINNESOTA WATER   RESOURCES RESEARCH CENTER MINNEAPOLIS JUNE 197
              1 176 P       65 TAB 58 FIG 78 REF

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              CONVERTING ORGANIC WASTES TO OIL  KEYWORDS  RECYCLING SEWAGE-SLUDGE FARM-WASTES AGRICULTURAL-WASTES  WOOD
              LIGNINS WATER TEMPERATURE CATALYSTS SOLVENTS CONVERSION OIL SOLID-WASTES LOW-SULFUR-OIL URBAN-REFUSE CARBO
              N-MONOXIDE LIQUID-FUELS WASTE-PRODUCTS CONTINUOUS-REACTOR  SUCROSE
              BUREAU OF MINES REPORT OF INVESTIGATION 1971 RI 7560        DEPARTMENT OF INTERIOR 1971 20 P 10 TAB 3 FIG

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              RUMINANTS FEEDS WATER-POLLUTION-CONTROL SEWAGE-TREATMENT ANIMAL-HUSBANDRY  FISH-PROTEIN
              CENTER PUBLICATION NO 71-3 COASTAL PLAINS CENTER FOR MARINE DEVELOPMENT SERVICES WILMINGTION NORTH CAROLIN
              A AUG 1971    113 P

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              DETERMINATION ON MERCURY IN SAMPLES FROM THE DUTCH  ENVIRONMENT  KEYWORDS  MERCURY NEUTRON-ACTIVATION-ANAL
              YSIS CHEMICAL-ANALYSIS INDUSTRIAL-WASTES POLLUTANT-IDENTIFICATION WATER-POLLUTION-SOURCES HEAVY-METALS SEP
              ARATION-TECHNIQUES IRRADIATION SEDIMENTS CATTLE BIRDS FOODS PLANTS MARINE FISH TOXICITY MILK WATER-ANALYSI
              S MARINE-ANIMALS SALMON HERRINGS COMMERCIAL-FISH AUTOMATION BIOLOGICAL-SAMPLES METHYL-MERCURY RHINE-RIVER
              SEALS-ANIMALS
              REPORT NO IRI-133-71-17 1971 21 P 1 TAB 12 FIG 10 REF

300 71 1106   ANON


              MANAGING OUR ENVIRONMENT


              KEYWORDS
              MANAGEMENT ENVIRONMENT AGRICULTURE WATER-POLLUTION-CONTROL  SEDIMENTS FARM-WASTES NUTRIENTS PHOSPHORUS ALG
              AE NITRATES  WATER-REUSE SALINITY PESTICIDES LIVESTOCK WASTE-DISPOSAL  OXIDATION-LAGOONS DEHYDRATION RUNOF
              F RADIOACTIVITY FALLOUT  BIOCONTROL INSECT-CONTROL IRRIGATION PREDATION PARASITISM  INSECT-RESISTANCE INSE
              CT-ATTRACTANTS PRECIPITATION-ATMOSPHERIC GENETICS EROSION-CONTROL AIR-POLLUTION TREES
              AGRICULTURE INFORMATION BULLETIN NO 351 DEPARTMENT OF       AGRICULTURE WASHINGTON D C APRIL 1971 48 P

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              WATER POLLUTION CONTROL LEGISLATION AGRICULTURAL RUNOFF  PART 6  KEYWORDS  AGRICULTURAL-CHEMICALS CHEMICAL
              -WASTES FARM-WASTES LIVESTOCK WATER-POLLUTION-SOURCES MISSOURI KANSAS RUNOFF FERTILIZ5RS PESTICIDES WASTE-
              DISPOSAL NITRATES LEACHING SALTS ASSOCIATED-COSTS EUTROPHICATION LEGAL-ASPECTS SOCIAL-ASPECTS NUTRIENTS BO
              DIES-OF-WATER LEGISLATION FEDERAL-GOVERNMENT AGRICULTURAL-RUNOFF
              HEARINGS BEFORE THE COMMITTEE ON PUBLIC WORKS SUBCOMMITTEE  ON AIR AND WATER POLLUTION 92ND CONGRESS 1ST S
              ESSION        APRIL 2 1971 P 2515-3188 208 TAB 64 FIG 420 REF
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300 71 1119   TSAO G T
              TREATMENT OF AQUEOUS AGRICULTURAL WASTES FOR CLEAN WATER AND FOR MICROBIAL PROTEIN PRODUCTION  KEYWORDS  O
              XYGEN ABSORPTION FOAMING AERATION CYTOLOGICAL-STUDIES FARM-WASTES WASTE-WATER-TREATMENT BIOLOGICAL-TREATME
              NT WALDORF-AERATOR CELL-GROWTH WHEY
              COMPLETION REPORT ISWRRI-33 IOWA STATE WATER RESOURCES      RESEARCH INSTITUTE AMES APRIL 1971 34 P 27 FIG
               12 REF

300 71 1126   BEYERS R J         BRISBIN I L         COLEMAN D C         GENTRY J B          GIBBONS J W
              SAVANNAH RIVER ECOLOGY LABORATORY ANNUAL REPORT 1971  KEYWORDS  BORON NUTRIENT-REQUIREMENT CYCLING-NUTRIEN
              TS RADIOACTIVITY-EFFECTS WATER-POLLUTION-EFFECTS ECOSYSTEMS THERMAL-POLLUTION RADIOECOLOGY SOUTHEAST-US MI
              CROORGANISMS BASS ECOLOGY SNAKES POULTRY AQUATIC-LIFE RODENTS AQUATIC-HABITATS AQUATIC-PLANTS AMPHIBIANS T
              URTLES PATH-OF-POLLUTANTS RESERVOIRS STREAMS  SOIL-WATER-PLANT-RELATIONSHIPS ABSORPTION
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300 71 1238   NGOODY P O         HARPER J P          COLLINS R K         WELLS G D           HEIDAR F A
              CLOSED SYSTEM WASTE MANAGEMENT FOR LIVESTOCK  KEYWORDS  VIBRATING-SCREEN HYDRAULIC-TRANSPORT ULTIMATE-DISP
              OSAL  AEROBIC-LAGOON-TREATMENT RECYCLED-WASHWATER  DIMENSIONAL-ANALYSIS LIVESTOCK-WASTE PHYSICAL-TREATMENT
                BIOLOGICAL-TREATMENT RECYCLE LIVESTOCK-WASTE
              PROJECT NO 13040 DKP AGRICULTURAL POLLUTION CONTROL        LABORATORY MICHIGAN STATE UNIVERSITY EAST LANS
              ING MICHIGAN  JUNE 1971 110 P

300 71 1245   DUFFER W R         KREIS R D           HARLIN C C JR
              EFFECTS OF FEEDLOT RUNOFF ON WATER QUALITY OF IMPOUNDMENTS  KEYWORDS  RESERVOIR FISHFILL AMMONIA DISSOLVED
              -OXYGEN RUNOFF ORGANIC-WASTES NUTRIENTS PHYTOPLANKTON MACROBENTHOS LIGHT-PENETRATION BEEF-CATTLE FEEDLOTS
              ZOOPLANKTON SOLIDS-CONCENTRATION  EFFECTS IMPOUNDMENTS
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300 71 1246   ANONYMOUS
              FEEDLOT WASTE MANAGEMENT  KEYWORDS  WATER-POLLUTION-CONTROL CONFINEMENT-PENS CATTLE POLLUTANTS  NON-STRUCT
              URAL-ALTERNATIVES PATH-OF-POLLUTANTS WATER-LAW  LEGISLATION REGULATION FARM-WASTES LAVESTOCK MANAGEMENT  F
              INANCING MISSOURI-RIVER RIVER-BASINS TECHNICAL-ASSISTANCE
              MISSOURI RIVER BASIN ANIMAL WASTE MANAGEMENT PILOT STEERING TASK GROUP KANSAS CITY MO JUNE 1971 45 P 2 FIG

300 71 1257   BUTCHBAKER A F     GARTON J E          MAHONEY G W A       PAINE M D
              EVALUATION OF BEEF CATTLE FEEDLOT WASTE MANAGEMENT  ALTERNATIVES  KEYWORDS  BEEF-WASTE WASTE-HANDLING-ALTE
              RNATIVES WASTE-TREATMENT-ALTERNATIVES ULTIMATE-DISPOSAL WASTE-HANDLING-COSTS FEEDLOT-DESIGN POLLUTION-CONT
              ROL BEEF-WASTE-MANAGEMENT
              WATER POLLUTION CONTROL RESEARCH SERIES GRANT NO 13040 FXG  OKLAHOMA AGRICULTURAL EXPERIMENT STATION OKLAH
              OMA STATE     UNIVERSITY STILLWATER OKLAHOMA NOV 1971 322 P

300 71 1261   DIETRICH R A
              INTERREGIONAL COMPETITION IN THE CATTLE FEEDING ECONOMY WITH SPECIAL EMPHASIS ON ECONOMIES OF SIZE  KEYWOR
              DS  FEED-LOTS CATTLE ECONOMICS SIZE REGIONAL-PRODUCTION-CHARACTERISTICS TRANSPORTATION-RATES LEAST-COST-SH
              IPMENT-ROUTES FEED-GRAINS
              PROJECT NO HM-2489 IN COOPERATION WITH THE US DEPT OF       AGRICULTURE TEXAS AGRICULTURAL EXPERIMENT STAT
              ION SEPT 1971 55 P 39 TAB 8 FIG

300 72 1003   ANON
              CATTLE FEEDLOTS AND THE ENVIRONMENT  KEYWORDS  FEED-LOTS DESIGN-CRITERIA AIR-POLLUTION WATER-POLLUTION  FA
              RM-WASTES LAGOONS RUNOFF WASTE-DISPOSAL  PACIFIC-NORTHWEST-US WASTE-MANAGEMENT SITE-SELECTION MANURE-MOUND
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              U S ENVIRONMENTAL PROTECTION AGENCY REGION X SEATTLE        WASHINGTON APRIL 1972 63 P 6 TAB 35 FIG 8 REF

300 72 1052   HUTCHINSON R E     HOFFMAN R A         JEFFREY R F
              EFFECT OF ANIMAL WASTES APPLIED TO SOILS ON SURFACE AND  GROUNDWATER SYSTEMS  KEYWORDS  WATER-POLLUTION-SO
              URCES GROUNDWATER FARM-WASTES NITROGEN  MAINE ON-SITE-INVESTIGATIONS ANALYTICAL-TECHNIQUES POULTRY  PATH-O
              F-POLLUTANTS SOIL-PROPERTIES RATES-OF-APPLICATION  INFILTRATION-RATES DATA-COLLECTIONS POULTRY-MANURE
              PROJECT COMPLETION REPORT OWRR A-020-ME1 MAINE WATER        RESOURCES RESEARCH CENTER ORONO SEPT 1972 38 P
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300 72 1070   EBY H J            SINGH V P
              PERIOCIDITY OF THE BLUE-GREEN ALGAE AND THEIR EFFECT ON THE EFFICIENCY OF MANURE-DISPOSAL LAGOONS  KEYWORD
              S  RECYCLING NUTRIENTS WASTE-WATER LAGOONS ALGAE BACTERIA  SEWAGE OXIDATION CLIMATIC-ZONES PROTEINS FARM-W
              ASTES INDIA  WASTE-DISPOSAL-LAGOONS SEASONAL-GROWTH
              PRODUCTION RESEARCH REPORT NO 142 AGRICULTURAL RESEARCH     SERVICE US DEPT OF AGRICULTURE APRIL 1972 8 P
              7 TAB 2 FIG

300 72 1085   KREIS R D          SCALF M R           MCNABB J
              CHARACTERISTICS OF RAINFALL RUNOFF FROM A BEEF CATTLE  FEEDLOT  KEYWORDS  CATTLE CONFINEMENT-PENS RAINFALL
              -RUNOFF-RELATIONSHIPS  POLLUTANTS FARM-WASTES NUTRIENTS BIO-CHEMICAL-OXYGEN-DEMAND CHEMICAL-OXYGEN DEMAND
              COLIFORMS STREPTOCOCCUS FEEDLOT  MANURE-WASTES WASTES-CHARACTERISTICS SOLIDS TOTAL-ORGANIS-CARBON
              ENVIRONMENTAL PROTECTION AGENCY REPORT NUMBER EPA-R2-72-061 SEPT 1972 43 P 10 TAB 2 FIG 26 REF

300 72 1146   ANON
              FEEDLOT WASTE UTILIZED EFFICIENTLY BY ANIMALS  KEYWORDS  FARM-WASTES SHEEP FEED-LOTS PROTEINS DIGESTIBILIT
              Y
              AGRICULTURE AT OSU OKLAHOMA STATE UNIVERSITY                STILLWATER OKLAHOMA SUMMER 1972 1 P

300 72 1157   CANADA ANIMAL WASTE MANAGEMENT GUIDE COMMITTEE
              CANADA ANIMAL WASTE MANAGEMENT GUIDE  KEYWORDS  FARM-WASTES LIVESTOCK PRODUCTION DESIGN MANAGEMENT POLLUTI
              ON MANURE-UTILIZATION NITROGEN FARM-LAGOONS AERATED-LAGOONS  AEROBIC-TREATMENT ANAEROBIC-DIGESTION WASTE-T
              REATMENT WASTE-STORAGE WASTE-DISPOSAL DEHYDRATION INCINERATION ZONING REGULATIONS LEGAL-ASPECTS EQUIPMENT
              FERTILIZERS CANADA COMPOSTING CANADIAN-LEGISLATION DEAD-BIRD-DISPOSAL
              CANADA 1972 57 P 9 TAB 4 FIG

300 72 1170   BRODIE H L
              POLLUTION LOADS IN PERCOLATE WATER FROM SURFACE SPREAD  SWINE WASTES  KEYWORDS  GROUNDWATER-POLLUTION FARM
              -WASTES HOGS PERCOLATION  FLOOD-IRRIGATION WASTE-DISPOSAL NITROGEN  CHEMICAL-OXYGEN-DEMAND PHOSPHATES CHLO
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               NEW-MEXICO OKLAHOMA IRRIGATION-WATER POLLUTANTS SURFACE-WATERS WATER-POLLUTION-CONTROL  SEDIMENT-DISCHARG
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              ANALYSIS NEBRASKA
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              FEEDLOT MANGEMENT V 14 NO 2 FEB 1972 P 10-16 60 7 FIG

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              ASTES RECYCLING  WASTE-DISPOSAL WASTE-TREATMENT OHIO PYROLYSIS  BUILDING-MATERIALS
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300 70 0487 ALGAE               NITRATE-REMOVAL FROM AGRICULTURAL WASTEWATER  KEYWORDS ALGAE CALIFORNIA DENITRIFICATION
300 70 0668 ALGAE               PHOTOSYNTHETIC RECLAMATION OF AGRICULTURAL SOLID AND LIQUID WASTE  KEYWORDS  ALGAE RECL
300 70 1101 ALGAE               BACTERICIDAL EFFECTS OF ALGAE ON ENTERIC ORGANISMS KEYWORDS ALGAE CULTURES ENTERIC-BACT
300 71 1106 ALGAE               MANAGING OUR ENVIRONMENT KEYWORDS MANAGEMENT ENVIRONMENT AGRICULTURE WATER-POLLUTION-CO
300 72 1070 ALGAE               PERIODICITY OF THE BLUE-GREEN ALGAE AND THEIR EFFECT ON THE EFFICIENCY OF MANURE-DISPOS
400 73 1063 ALGAE               AGRICULTURE AND ENVIRONMENT KEYWORDS PHOTOSYNTHESIS WATER-POLLUTION NITRATES PHOSPHATES
500 70 0407 ALGAE               EFFECTS OF SURFACE-RUNOFF ON THE FEASIBILITY OF MUNICIPAL ADVANCED WASTE-TREATMENT  KEY
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100 70 1194 ALGAL-CONTROL       REVIEW OF NATIONAL RESEARCH POLICY ON EUTROPHICATION PROBLEMS  KEYWORDS EUTROPHICATION
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200 69 0482 ALGAL-GROWTH        THE EFFECTS OF FARM WASTES ON THE POLLUTION OF NATURAL WATERS  KEYWORD  GROUNDWATER NUT
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100 69 1198 ALGEA               CHEMICAL AND DETRITAL FEATURES OF PALOUSE RIVER IDAHO RUNOFF FLOWARE KEYWORDS
100 68 0306 ALKALINE            ANAEROBIC DIGESTION FAILURES  KEYWORDS DIGESTION SLUDGE DISPOSAL AMMONIUM ALKALINE BUIL
100 69 0679 ALKALINE            NITROGEN LOSSES FROM ALKALINE WATER IMPOUNDMENTS  KEYWORDS  EUTROPHICATION AMMONIA NITR
100 63 0338 ALKALINITY          DIGESTION-TESTS OF LIVESTOCK-WASTES  KEYWORDS  BOD COD CATTLE POULTRY SLUDGE-DIGESTION
100 65 0503 ALKALINITY          THE MICROBIOLOGY OF BUILT UP POULTRY MANURE  KEYWORDS  PH BACTERIA ALKALINITY LABORATOR
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100 65 0699  BACTERIA            THE MICROBIOLOGY OF BUILT UP POULTRY LITTER KEYWORDS MICROBIOLOGY BACTERIA FARM-WASTES
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100	65	0075	COD	HOG-WASTE-DISPOSAL BY LAGOONING KEYWORDS ODOR BOD COD E-COLI SAMPLING SEPTIC-TANKS ALGA
100	65	0378	COD	TREATMENT OF LIVESTOCK-WASTE - A LABORATORY STUDY KEYWORDS BOD COD ANAEROBIC-DIGESTIO
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100 69 0096  CONFINEMENT           IDENTIFICATION OF GASES IN A CONFINEMENT SWINE BUILDING ATMOSPHERE  KEYWORDS  ODOR ORGA
100 70 0050  CONFINEMENT           TREATMENT AND DISPOSAL OF ANIMAL WASTES  KEYWORDS  LAGOONS  NUTRIENTS CONFINEMENT HOLDI
100 70 0102  CONFINEMENT           POLLUTION CONTROL-FEEDLOT OPERATIONS  KEYWORDS  HOGS CONFINEMENT LABOR WATER-POLLUTION
200 64 0750  CONFINEMENT           LAGOONING OF LIVESTOCK WASTES IN SOUTH DAKOTA  KEYWORD  ANAEROBIC AEROBIC POULTRY CONFI
200 66 0119  CONFINEMENT           BIOLOGICAL INTERRELATIONSHIPS BETWEEN FECES AND FLIES KEYWORDS  FILTH-FLIES CONFINEMENT
200 66 0122  CONFINEMENT           METHODS OF HANDLING POULTRY-WASTE MATERIAL  KEYWORDS  ODOR  POULTRY WASTE-STORAGE DISPO
200 66 0125  CONFINEMENT           SLOPING FLOORS FOR BEEF-CATTLE FEEDLOTS  KEYWORDS  DISPOSAL CONFINEMENT SLATTED-FLOORS
200 66 0126  CONFINEMENT           MATERIALS HANDLING AND LABOR IN FREE-STALL AND LOOSE HOUSING KEYWORDS  CATTLE CONFINEME
200 66 0129  CONFINEMENT           WATER METABOLISM STUDIES MAY ASSIST WITH WASTE DISPOSAL KEYWORDS  POULTRY ODOR CLAYS CO
200 69 0078  CONFINEMENT           OXYGENATION CAPACITIES OF OXIDATION DITCH ROTORS FOR CONFINEMENT LIVESTOCK BUILDINGS  K
200 69 0177  CONFINEMENT           FIELD TESTS OF OXIDATION DITCHES IN CONFINEMENT SWINE BUILDING  KEYWORDS  ROTORS OXYGE
200 69 0562  CONFINEMENT           ASSESSING  THE PROBLEM OF FEEDLOT POLLUTION  KEYWORDS  RUNOFF CATTLE LEGISLATION CONFIN
200 71 0816  CONFINEMENT           ECONOMICS OF WASTE DISPOSAL FROM CONFINED LIVESTOCK  KEYWORDS  AEROBIC-TREATMENT COSTS
300 69 0003  CONFINEMENT           CONFINEMENT SWINE HOUSING - SPACE REQUIREMENTS-FACTSHEET KEYWORDS  SIZE TEMPERATURE SEA
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100 71 0695  CONFINEMENT-PENS      CONTROL OF POULTRY HOUSE VENTILATION SYSTEMS USING SOLID-STATE CONTROLS  KEYWORD  CONFI
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400 73 1073  CORN                 NITRATE CONTENT OF PERCOLATES FROM MANURED LYSIMETERS KEYWORDS NITRATES FARM-WASTES LYS
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600 73 1065  CORN-FIELD           EFFECTS OF SWINE LAGOON EFFLUENT OF THE SOIL AND PLANT TISSUE KEYWORDS
100 70 0421  CORN-ROOTWORM        EFFECTS OF MANURE APPLICATIONS AND MITE PREDATION ON CORN ROOTWORM POPULATIONS IN MINNE
300 67 1250  CORRALS              DISTRIBUTION OF NITRATES AND OTHER WATER POLLUTANTS UNDER FIELDS AND CORRALS IN THE MID
200 69 0196  CORRELATION-ANALYS THE INFLUENCE OF VARIOUS FACTORS ON POULTRY LITTER COMPOSITION  KEYWORDS  NITROGEN CARB
200 69 0708  CORRELATION-ANALYS TOTAL ORGANIC CARBON DETERMINATIONS ON SWINE WASTE EFFLUENTS  KEYWORDS  BOD COD TEST-PR
300 69 0004  CORROSION            CONFINEMENT SWINE HOUSING - SLOTTED FLOORS-FACT SHEET  KEYWORDS  MATERIALS REINFORCED-C
100 66 0290  CORYNEFORM           CORYNEFORM BACTERIA POULTRY DEEP LITTER KEYWORDS  CORYNEFORM BACTERIA POULTRY LITTER
100 70 0019  COST                 CONTROL OF ODORS FROM ANIMAL WASTES KEYWORDS CHEMICALS COST ODOR-PANEL MASKING-AGENTS D
200 66 0151  COST                 ECONOMIC EVALUATION OF LIQUID-MANURE DISPOSAL FOR CONFINEMENT FINISHING OF HOGS  KEYWOR
200 66 0152  COST                 ECONOMICS OF LIQUID-MANURE DISPOSAL FROM CONFINED LIVESTOCK KEYWORDS  COD BOD COST NUTR
200 66 0156  COST                 BIOLOGICAL TREATMENT OF ANIMAL WASTES  KEYWORDS  SWINE COST BOD NITROGEN NITROGEN-BALAN
300 70 0743  COST                 GUIDELINES FOR DEVELOPING COMMERCIAL FEEDLOTS IN KANSAS  KEYWORDS  CATTLE ECONOMICS IRR
400 71 0267  COST                 WASTE MANAGEMENT WHAT DOES IT COST  KEYWORDS  WASTE DISPOSAL COSTS COST ANALYSIS COST F
400 71 0267  COST                 WASTE MANAGEMENT WHAT DOES IT COST  KEYWORDS  WASTE DISPOSAL COSTS COST ANALYSIS COST F
400 71 0504  COST                 COST OF DEHYDRATING POULTRY MANURE  KEYWORDS  SHELF-LIFE FERTILIZERS EQUIPMENT COST DEH
100 65 0366  COSTS                LIQUID HANDLING OF POULTRY MANURE  KEYWORDS  SLUDGE ODOR DISPOSAL DESIGN-CRITERIA RECYC
100 66 0347  COSTS                AEROBIC-PURIFICATION OF FARM WASTE  KEYWORDS BOD COD COSTS  BIOLOGICAL-TREATMENT OXIDAT
100 70 0047  COSTS                PRINCIPLES AND PRACTICES OF BEEF CATTLE FEEDLOTS  KEYWORDS  DISEASES COSTS PROFITS NUTR
100 70 0340  COSTS                FERTILIZATION OF ANNUAL RANGELAND WITH CHICKEN MANURE  KEYWORDS  POULTRY CROP-RESPONSE
100 70 0342  COSTS                IN VITRO DIGESTIBILITY OF CHEMICALLY-TREATED FECES  KEYWORDS  DIGESTION FERMENTATION CO
100 70 0368  COSTS                AGRICULTURE-WASTE RESEARCH-NEEDS  KEYWORDS  POULTRY DISPOSAL ODOR COSTS DRYING EQUIPMEN
100 70 0510  COSTS                CATTLE, SWINE AND CHICKEN MANURE CHALLENGES WASTE DISPOSAL METHODS  KEYWORDS  COSTS FER
100 70 1194  COSTS                REVIEW OF NATIONAL RESEARCH POLICY ON EUTROPHICATION PROBLEMS  KEYWORDS EUTROPHICATION
100 71 0574  COSTS                OXIDATION DITCH IN A CONFINEMENT BEEF BUILDING  KEYWORDS CONFINEMENT-PENS BOD COD COSTS
100 71 0680  COSTS                ECONOMIES OF RECOVERY AND DISTRIBUTION OF ANIMAL WASTE  KEYWORDS  TRANSPORTATION PROCES
100 71 1047  COSTS                OXIDATION DITCH IN A CONFINEMENT BEEF BUILDING KEYWORDS FARM-WASTES CONFINEMENT-PENS OX
200 69 0157  COSTS                ANIMAL WASTE MANAGEMENT  KEYWORDS  BOD COD DO PH WATER-POLLUTION AIR-POLLUTION SOIL-CON
200 69 0186  COSTS                MANURE CONSERVATION  KEYWORDS  POULTRY FERTILIZER POTASH AIR-CONDITIONING GROSS-PROFIT
200 69 0200  COSTS                THE ECONOMICS OF POULTRY MANURE DISPOSAL  KEYWORDS  FERTILIZERS NITROGEN PHOSPHORUS POT
200 69 0202  COSTS                ECONOMIC EVALUATION OF LIQUID MANURE SYSTEMS FOR FREE STALL DAIRY BARNS  KEYWORDS  COST
200 69 0427  COSTS                MANAGEMENT OF ANIMAL FEEDLOT WASTES - LAND SPREADING AS A DISPOSAL PROCESS KEYWORDS  MU
200 70 0114  COSTS                SWINE MANURE - LIABILITY OR ASSET  KEYWORDS  WATER-POLLUTION AIR-POLLUTION ECONOMICS CO
200 70 0234  COSTS                FARM WASTES  KEYWORDS  DISPOSAL UNITED-KINGDOM SLURRIES BOD COD DO ODOR COSTS EQUIPMENT
200 70 0235  COSTS                ORIGINS AND NATURE OF FARM WASTES  KEYWORDS  DISPOSAL COSTS LEGAL-ASPECTS ECONOMICS UK
200 70 0243  COSTS                MINIMIZING POULTRY WASTE PROBLEMS  KEYWORDS  COSTS DISPOSAL ODOR BOD UK FERTILIZERS SLU
200 70 0245  COSTS                MINIMIZING THE WASTE PROBLEM WITH CATTLE  KEYWORDS  SLURRIES DISPOSAL COSTS CONFINEMENT
200 70 0246  COSTS                BUILDING DESIGN  KEYWORDS  MANAGEMENT COSTS DESIGN GASES DISPOSAL LAGOONS BUILDINGS STO
200 70 0247  COSTS                BUILDING DESIGN AND MANURE DISPOSAL  KEYWORDS  STORAGE SLURRIES DISPOSAL DESIGN-CRITERI
200 70 0250  COSTS                LAND DISPOSAL AND STORAGE OF FARM WASTES  2 HANDLING AND DISTRIBUTION  KEYWORDS  EQUIPM
200 70 0253  COSTS                TREATMENT OF FARM WASTES  KEYWORDS  DISPOSAL LAGOON AERATION ACTIVATED SLUDGE SLURRIES
200 70 0321  COSTS                WASTE-DISPOSAL AND POLLUTION, POULTRY-PROCESSING  KEYWORDS  RENDERING-PLANT ODORS SEWAG
200 71 0274  COSTS                WHAT DO WE MEAN BY POLLUTION  KEYWORDS  ENVIRONMENT-QUALITY STANDARDS TAXATION PRICING
200 71 0283  COSTS                ECONOMICS OF POLLUTION-CONTROL  KEYWORDS  STANDARDS GOALS ENVIRONMENTAL-QUALITY COSTS B
200 71 0610  COSTS                WATER POLLUTION AND THE FARMER  KEYWORDS  RUNOFF COSTS PESTICIDES GOVERNMENT-FINANCE CO
200 71  816  COSTS                ECONOMICS OF WASTE DISPOSAL FROM CONFINED LIVESTOCK  KEYWORDS  AEROBIC-TREATMENT COSTS
200 71 0818  COSTS                THE ECONOMICS OF SWINE WASTE DISPOSAL  KEYWORDS  COSTS ECONOMIC-FEASIBILITY AEROBIC-TRE
200 71 0819  COSTS                ECONOMIC IMPLICATIONS OF ENVIRONMENTAL QUALITY LEGISLATION FOR CONFINED ANIMAL FEEDING
200 71 0820  COSTS                COSTS OF MAINTAINING SPECIFIED LEVELS OF WATER POLLUTION CONTROL FOR CONFINED CATTLE FE
200 71 0839  COSTS                AEROBIC BIOLOGICAL BREAKDOWN OF FARM WASTE  KEYWORD  DENITRIFICATION ACTIVATED-SLUDGE C
200 71 0846  COSTS                NUTRITIVE VALUE OF CHICKEN MANURE FOR CATTLE KEYWORDS FARM-WASTES RECYCLING CATTLE POUL
200 71 0850  COSTS                THE EFFECTS OF INCLUDING DRIED POULTRY WASTE IN THE FEED OF LAYING HENS  KEYWORD  RECYC
200 71 1094  COSTS                AGRICULTURE AND POLLUTION--SOCIO-ECONOMIC ASPECTS KEYWORDS WATER-POLLUTION ECONOMICS SU
200 73 1082  COSTS                COSTS FOR LARGE SCALE CONTINUOUS PYROLYSIS OF SOLID WASTES  KEYWORDS SOLID-WASTES COSTS
300 69 0006  COSTS                SWINE WASTE MANAGEMENT-OXIDATION DITCH FOR TREATING HOG WASTES-FACT SHEET  KEYWORDS  DE
300 70 0208  COSTS                DRYING ANIMAL WASTE  KEYWORDS POULTRY CATTLE HOGS MOISTURE-CONTENT NUTRIENTS DENSITY CO
300 70 0384  COSTS                THE ECONOMICS OF CLEAN WATER  VOLUME TWO  ANIMAL WASTES PROFILE KEYWORDS COSTS WATER-PO
300 71 0704  COSTS                PLANNING ANIMAL WASTE DISPOSAL SYSTEMS  KEYWORDS  REGULATION ECONOMICS GOVERNMENT-AGENC
400 66 0088  COSTS                POULTRY-MANURE DISPOSAL - IS THERE A PROBLEM  KEYWORDS COSTS NUTRIENTS VALUE FERTILIZER
400 70 0097  COSTS                POULTRY MANURE LAGOON DESIGN  KEYWORDS  RECIRCULATED-WATER  AERATION EQUIPMENT COSTS FL
400 70 0111  COSTS                UNDER-CAGE MANURE DRYING SYSTEM SOLVES ODOR PROBLEMS  KEYWORDS  POULTRY COSTS ECONOMICS
400 70 0351  COSTS                DAIRY-SET-UP FOR 200 COWS  KEYWORDS  LAGOON COSTS FREE-STALL-HOUSING EVAPORATIVE-LAGOON
400 70 0357  COSTS                FROM THE ALS  MECHANICAL-CLEANING OF COWSHEDS  KEYWORDS DAIRY-CATTLE AGE COSTS SPECIFIC
400 71 0267  COSTS                WASTE MANAGEMENT WHAT DOES IT COST  KEYWORDS  WASTE DISPOSAL COSTS COST ANALYSIS COST F
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500 70 0409 COSTS              ECONOMIC-ASPECTS  KEYWORDS  WATER-QUALITY COSTS BENEFITS QUALITY-LEVELS EXTERNALITIES M
300 71 1056 COST-ALLOCATION    AN ANALYSIS OF THE ECONOMIC IMPLICATIONS OF THE PERMIT SYSTEM OF WATER ALLOCATION KEYWO
200 69 0199 COST-ANALYSIS      RELATIVE ECONOMICS OF ANIMAL WASTE DISPOSAL BY SELECTED WET AND DRY TECHNIQUES  KEYWORD
200 70 1113 COST-ANALYSIS      AERATED LAGOON TREATMENT OF LONG ISLAND DUCK WASTES KEYWORDS OXIDATION-LAGOONS FARM-WAS
300 71 1056 COST-ANALYSIS      AN ANALYSIS OF THE ECONOMIC IMPLICATIONS OF THE PERMIT SYSTEM OF WATER ALLOCATION KEYWO
700 72 1049 COST-ANALYSIS      ECONOMICS OF WATER QUALITY MANAGEMENT  EXEMPLIFIED BY SPECIFIED POLLUTANTS IN AGRICULTU
200 69 0158 COST-BENEFIT-RATIO REFLECTIONS ON POLLUTION CONTROL  KEYWORDS  WATER-QUALITY COST-BENEFIT-RATIO ENVIRONMEN
200 71 0733 COST-COMPARISONS   ALTERNATIVES FOR WASTE MANAGEMENT FOR OPEN BEEF FEEDLOTS  KEYWORD  RUNOFF SOLID-WASTES
200 71 0828 COST-COMPARISONS   DISPOSAL OF BEEF MANURE BY DEEP PLOWING  KEYWORDS  DEEP-TILLAGE COST-COMPARISONS CROP-P
300 70 1192 COST-SHARING       IMPLICATIONS OF WATER QUALITY LAWS FOR THE FEEDLOT INDUSTRY KEYWORDS CONTROL POLLUTION-
300 71 0752 COST-SHARING       ROLE OF THE SOIL CONSERVATION SERVICE IN DESIGN OF FEEDLOT WASTE MANAGEMENT FACILITIES
100 73 1162 COTTON             PERSISTENCE OF MANURE PHOSPHORUS AVAILABILITY IN CALCAREOUS SOIL KEYWORDS
100 70 1090 COUMAPHUS          COUMAPHUS AS A FEED ADDITIVE FOR THE CONTROL OF HOUSE FLY LARVAE IN COW MANURE KEYWORDS
100 65 1091 COUMAPHUS-ORAL-DRE TOXICITY OF DROPPINGS FROM COUMAPHOS-FED HENS TO LITTLE HOUSE FLY LARVAE KEYWORDS
400 71 0315 COW                IF COW MANURE BREAKS DOWN OUT KEYWORDS  COW DDT
400 73 1068 COWDOMINIUM        NEW FEEDLOT CONCEPT USES CONVERTED MANURE AS FEED KEYWORDS RECYCLING FARM-WASTES CATTLE
400 73 1068 COWMEL             NEW FEEDLOT CONCEPT USES CONVERTED MANURE AS FEED KEYWORDS RECYCLING FARM-WASTES CATTLE
400 71 0293 COW-MANURE         SODIUM EGG-SHELLS EFF-QUALITY EGG-PRODUCTION ALBUMEN SOUTHERN WORKERS REPORT RESEARCH K
400 72 1138 COW-TOILET         HOUSED CONFINEMENT AN ANSWER FOR FEEDING IN NORTHERN CALIFORNIA KEYWORDS
200 71 0617 CO-OPEXTENSION-SER THE ROLE OF EXTENSION IN POLLUTION ABATEMENT IN VIRGINIA  KEYWORDS  POULTRY ADMINISTRAT
100 63 1064 CO-RAL             TOXICITY TO HOUSE FLIES AND HORN FLIES OF MANURE FROM INSECTICIDE FED CATTLE KEYWORDS
300 70 1104 CRABS              FISH AS POTENTIAL VECTORS OF HUMAN BACTERIAL DISEASES KEYWORDS DISEASES VECTROS-BIOLOGY
600 69 1006 CRANIOTOMY         HYPOTHALAMIC TEMPERATURE REGULATION IN CATTLE KEYWORDS CATTLE TEMPERATURE-CONTROL HUMID
200 71 0612 CREDIT             PROVIDING TECHNICAL AND FINANCIAL ASSISTANCE TO FARMERS FOR ANIMAL WASTE DISPOSAL SYSTE
100 64 0345 CREEK-WATER        BOVINE-SALMONELLOSIS ASSOCIATED WITH CONTAMINATED CREEK-WATER AND HUMAN-INFECTION  KEYW
100 69 0037 CRITERIA           WATER POLLUTION CONTROL LEGISLATION-CONDENSATION  KEYWORDS  WATER-QUALITY-ACT BOD PHOSP
100 71 0582 CRITERIA           CRITERIA NEEDED TO DESIGN ANIMAL QUARTERS FOR COMFORT AND PRODUCTIVITY  KEYWORDS  AIR-Q
100 71 0571 CROP               EFFECT OF METHOD OF MANURE HANDLING ON CROP YIELDS, NUTRIENT RECOVERY AND RUNOFF LOSSES
200 71 0775 CROP               TRANSPORT OF POLLUTANTS FROM SLOPING CATTLE FEEDLOTS AS AFFECTED BY RAINFALL INTENSITY,
200 71 0856 CROP               GROWTH RESPONSE OF PLANTS UNDER SPRINKLER IRRIGATION WITH DAIRY WASTES  KEYWORD  FERTIL
300 71 0412 CROP               THE INFLUENCE OF ASHED POULTRY MANURE ON SOIL, SNAPBEANS, AND TOMATOES  KEYWORDS  CROP
300    1077 CROPLANDS          SOIL CONDITIONS UNDER FEEDLOTS AND ON LAND TREATED WITH LARGE AMOUNTS OF ANIMAL WASTES
100 70 0417 CROPS              ACCUMULATION OF PHOSPHATES IN WATER  KEYWORDS  RUNOFF FERTILIZERS SOURCES POLLUTANTS SO
100 70 1227 CROPS              AGRICULTURAL LIVESTOCK WASTES LITERATURE REVIEW KEYWORDS AGRICULTURE INDUSTRIAL-WASTES
200 68 0724 CROPS              GUIDELINES TO LAND REQUIREMENTS FOR DISPOSAL OF LIQUID MANURE  KEYWORDS  POULTRY CONFIN
200 71 0798 CROPS              THE ROLE OF MICROORGANISMS IN THE MANAGEMENT OF ANIMAL WASTES ON BEEF CATTLE FEEDLOTS
200 71 1252 CROPS              NITRATE POLLUTION OF WATER KEYWORDS WATER-POLLUTION-SOURCES GROUNDWATER SURFACE-WATERS
300 49 1210 CROPS              MEASURE AND ELEMENTS OF DAMAGES FOR POLLUTION OF A STREAM KEYWORDS JUDICIAL-DECISIONS D
300 68 1122 CROPS              NITROGEN CYCLE IN SURFACE AND SUBSURFACE WATERS KEYWORDS DOMESTIC-ANIMALS WASTES FERTIL
500 71 1072 CROPS              HUMAN AND ANIMAL WASTES AS FERTILIZERS KEYWORDS FARM-WASTES SEWAGE WASTE-DISPOSAL IRRIG
100 62 1220 CROP-PRODUCTION    WATER POLLUTION RESULTING FROM AGRICULTURAL ACTIVITIES KEYWORDS WATER-POLLUTION-SOURCES
200 71 0828 CROP-PRODUCTION    DISPOSAL OF BEEF MANURE BY DEEP PLOWING  KEYWORDS  DEEP-TILLAGE COST-COMPARISONS CROP-P
200 72 1029 CROP-PRODUCTION    CONCLUDING COMMENTS KEYWORDS FARM-WASTES CROP-PRODUCTION LIVESTOCK SOILS MARKETING  WAS
300 71 1035 CROP-PRODUCTION    IMPLICATIONS OF CROP-PRODUCTION TECHNOLOGY FOR ENVIRONMENTAL QUALITY KEYWORDS
300 71 1035 CROP-PRODUCTION-TE IMPLICATIONS OF CROP-PRODUCTION TECHNOLOGY FOR ENVIRONMENTAL QUALITY KEYWORDS
100 70 0048 CROP-RESPONSE      SOIL FERTILITY UNDER CONTINUOUS CULTIVATION IN NORTHERN NIGERIA  I THE ROLE OF ORGANIC
100 70 0340 CROP-RESPONSE      FERTILIZATION OF ANNUAL RANGELAND WITH CHICKEN MANURE  KEYWORDS  POULTRY CROP-RESPONSE
100 70 1037 CROP-RESPONSE      NITROGEN IN AGRICULTURE  THE PROBLEMS AND THE EFFECT ON THE ENVIRONMENT KEYWORDS
200 71 0648 CROP-RESPONSE      FERTILIZER PRACTICES WHICH MINIMIZE NUTRIENT LOSS  KEYWORDS  FERTILIZER-REQUIREMENTS CR
200 71 0826 CROP-RESPONSE      CROP PRODUCTION AND SOIL ANALYSIS AS AFFECTED BY APPLICATIONS OF CATTLE FEEDLOT WASTE
200 71 0828 CROP-RESPONSE      DISPOSAL OF BEEF MANURE BY DEEP PLOWING  KEYWORDS  DEEP-TILLAGE COST-COMPARISONS CROP-P
200 71 0831 CROP-RESPONSE      EFFECT OF RATE OF POULTRY MANURE APPLICATION ON SELECTED SOIL CHEMICAL PROPERTIES  KEYW
200 71 0833 CROP-RESPONSE      EFFECT OF MANURE HANDLING SYSTEMS ON PLANT NUTRIENT CYCLING KEYWORDS  FERTILIZATION CRO
200 71 0853 CROP-RESPONSE      RECYCLING BROILER HOUSE LITTER ON TALL FESCUE PASTURES AT DISPOSAL RATES AND EVIDENCE O
600 71 0271 CROP-RESPONSE      GROWING CORN IN GROWTH CHAMBERS WITH DIFFERENT MANURE TREATMENTS  KEYWORDS  DISPOSAL CR
200 69 0174 CROP-UTILIZATION   THE NITROGEN PROBLEM IN THE LAND DISPOSAL OF LIQUID MANURE  KEYWORDS  GROUNDWATER NITRA
600 72 1169 CROP-YIELD         CROP YIELDS FROM LAND RECEIVING LARGE MANURE APPLICATIONS KEYWORDS APPLICATION-METHODS
100 70 0024 CROSS-INFECTIONS   PROBABLE SOURCES OF SALMONELLAE ON A POULTRY FARM KEYWORDS INVESTIGATIONS ANIMALS RODEN
200 72 1152 CROWDING           PERFORMANCE OF BEEF ANIMALS AS AFFECTED BY CROWDING AND THERMAL ENVIROMENT DURING A FAL
100 65 1079 CRUDE-PROTEIN      UTILIZATION OF DIFFERENT LEVELS OF POULTRY LITTER NITROGEN  BY SHEEP KEYWORDS
100 68 0502 CRUDE-PROTEIN      MANURE-PRODUCTION BY BROILERS  KEYWORDS  POULTRY-LITTER MOISTURE-CONTENT CRUDE-PROTEIN
600 72 1169 CULTIVATION        CROP YIELDS FROM LAND RECEIVING LARGE MANURE APPLICATIONS KEYWORDS APPLICATION-METHODS
700 72 1049 CULTIVATION        ECONOMICS OF WATER QUALITY MANAGEMENT  EXEMPLIFIED BY SPECIFIED POLLUTANTS IN AGRICULTU
100 70 0018 CULTURES           SALMONELLA SPP  AND SEROTYPES OF ESCHERICHIA COLI ISOLATED  FROM THE LESSER MEALWORM CO
100 71 1212 CULTURES           EFFECTS OF MULTIPLE USE ON WATER QUALITY OF HIGH MOUNTAIN WATERSHEDS BACTERIOLOGICAL IN
300 70 1101 CULTURES           BACTERICIDAL EFFECTS OF ALGAE ON ENTERIC ORGANISMS KEYWORDS ALGAE CULTURES ENTERIC-BACT
500 71 1254 CULTURES           ISOLATION OF ANAEROBES KEYWORDS  ISOLATION CULTURES SOIL-BACTERIA PROTOZOA FUNGI PHOTOS
500 71 1254 CULTURE-MEDIA      ISOLATION OF ANAEROBES KEYWORDS  ISOLATION CULTURES SOIL-BACTERIA PROTOZOA FUNGI PHOTOS
100 69 1198 CURRENTS-WATER     CHEMICAL AND DETRITAL FEATURES OF PALOUSE RIVER IDAHO RUNOFF FLOWARE KEYWORDS
300 70 0455 CURRENT-TECHNOLOGY ANIMAL WASTE DISPOSAL BECOMES A MORE DIFFICULT PROBLEM  KEYWORDS  ODOR GASES LAGOONS RE
200 69 0162 CUTLOOK            THEORY AND FUTURE OUTLOOK OF ANIMAL WASTE TREATMENT IN CANADA AND THE UNITED STATES  KE
200 71 1234 CYANOPHYTA         SOME OBSERVATIONS ON THE LIMNOLOGY OF A POND RECEIVING ANIMAL WASTES KEYWORDS
200 71 0833 CYCLING            EFFECT OF MANURE HANDLING SYSTEMS ON PLANT NUTRIENT CYCLING KEYWORDS  FERTILIZATION CRO
100 73 1162 CYCLING-NUTRIENTS  PERSISTENCE OF MANURE PHOSPHORUS AVAILABILITY IN CALCAREOUS SOIL KEYWORDS
300 71 1126 CYCLING-NUTRIENTS  SAVANNAH RIVER ECOLOGY LABORATORY ANNUAL REPORT 1971 KEYWORDS BORON NUTRIENT-REQUIREMEN
400 72 1166 CYCLING-NUTRIENTS  HOW MUCH MANURE PER ACRE KEYWORDS ANIMAL-WASTES WASTE-DISPOSAL HOGS CATTLE
300 71 1119 CYTOLOGICAL-STUDIE TREATMENT OF AQUEOUS AGRICULTURAL WASTES FOR CLEAN WATER AND FOR MICROBIAL PROTEIN PROD
200 71 0771 CZECHOSLOVAKIA     TECHNOLOGICAL AND TECHNICAL CONCEPTIONS OF MANURE HANDLING  IN CZECHOSLOVAKIA  KEYWORDS
100 67 0713 D                  SOME AEROBIC DECOMPOSITION PROPERTIES OF DAIRY CATTLE MANUREKEYWORDS D COD CATTLE NITRO
100 65 0346 DAIRY              LAGOONS FOR LIVESTOCK MANURE  KEYWORDS  POULTRY DAIRY SWINE BOD ANAEROBIC-DIGESTION INF
100 67 0713 DAIRY              SOME AEROBIC DECOMPOSITION PROPERTIES OF DAIRY CATTLE MANUREKEYWORDS D COD CATTLE NITRO
100 69 0030 DAIRY              TREATMENT OF DAIRY MANURE BY LAGOONING  KEYWORDS  BIODEGRADATION ALGAE BOD ANAEROBIC-DI
100 69 0445 DAIRY              EFFLUENT DISPOSAL  KEYWORDS  DAIRY NEW-ZEALAND EFFLUENT
100 71 0450 DAIRY              NITRATE AND SALT IN SOILS AND GROUND-WATERS FROM LAND DISPOSAL OF DAIRY MANURE  KEYWORD
200 66 0134 DAIRY              OPERATING CHARACTERISTICS OF TWO AEROBIC-ANAEROBIC DAIRY MANURE TREATMENT SYSTEMS  KEYW
200 68 0694 DAIRY              THE MANAGEMENT PRINCIPLES APPLICATION TO THE DISPOSAL OF CATTLE MANURE TO PREVENT POLLU
200 69 0056 DAIRY              PRELIMINARY RESULTS OF A NOVEL BIOLOGICAL PROCESS FOR TREATING DAIRY WASTES  KEYWORDS
200 69 0167 DAIRY              AEROBIC STORAGE OF DAIRY CATTLE MANURE  KEYWORDS  AERATION  TEMPERATURE ODOR COD LOADIN
200 69 0201 DAIRY              ECONOMIC RETURN FROM VARIOUS LAND DISPOSAL SYSTEMS FOR DAIRY CATTLE MANURE  KEYWORDS  F
200 69 0202 DAIRY              ECONOMIC EVALUATION OF LIQUID MANURE SYSTEMS FOR FREE STALL DAIRY BARNS  KEYWORDS  COST
200 69 0522 DAIRY              FUTURE-TRENDS IN LIVESTOCK-PRODUCTION  KEYWORDS  WISCONSIN  WASTE-DISPOSAL DAIRY CATTLE
200 69 0524 DAIRY              CONSIDERATIONS IN SELECTING DAIRY MANURE-DISPOSAL SYSTEMS KEYWORDS  LABOR ANNUAL-COST I
200 69 0706 DAIRY              HANDLING, STORAGE, AND TREATMENT OF DAIRY AND BEEF CATTLE WASTES IN CONFINEMENT SYSTEMS  K
200 70 0221 DAIRY              LAND-DISPOSAL OF DAIRY-FARM-WASTE  KEYWORDS EFFLUENT NITRATE PHOSPHATE GROUNDWATER WATE
200 70 0222 DAIRY              THE NITROGEN-CYCLE OF A DAIRY FARM  KEYWORDS NUTRIENTS FERTILIZATION FOLIAR-APPLICATION
200 70 0227 DAIRY              RATES OF WATER-INFILTRATION RESULTING FROM APPLICATIONS OF  DAIRY-MANURE  KEYWORDS  ROT
200 71 0665 DAIRY              WASTE MANAGEMENT ON A MODERN DAIRY FARM  KEYWORDS  CATTLE SOIL-DISPOSAL-FIELDS SEPTIC-T
200 71 0782 DAIRY              MULTISTAGE LAGOON SYSTEMS FOR TREATMENT OF DAIRY FARM WASTE KEYWORDS  SPRINKLER-IRRIGAT
200 71 0792 DAIRY              CHROMATOGRAPHIC IDENTIFICATION OF MALODORS FROM DAIRY ANIMAL WASTE  KEYWORDS  CHROMATOG
200 71 0806 DAIRY              COMPOSTING DAIRY COW WASTES  KEYWORDS  AEROBIC-BACTERIA CATTLE HAY SILAGE GRAIN ODORS C
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200 71 0838	DAIRY	NITROGEN TRANSFORMATION DURING AEROBIC DIGESTION AND DENITRIFICATION OF DAIRY CATTLE WA
200 71 0850	DAIRY	THE EFFECTS OF INCLUDING DRIED POULTRY WASTE IN THE FEED OF LAYING HENS KEYWORD RECYC
400 64 0358	DAIRY	TREATMENT OF FARM-EFFLUENTS KEYWORDS DAIRY HOGS BOD VOLUME WASTE-WATER SURFACE-WATER
400 71 0731	DAIRY	DISPOSING OF ANIMAL WASTES KEYWORDS FARM-WASTES DAIRY LAGOONS RUNOFF FERTILIZER DISPO
600 72 1156	DAIRY	SEEPAGE LOSSES AND FERTILIZER PRESERVATION IN MANURE STACKING PRACTICE KEYWORDS
100 65 0344	DAIRY-CATTLE	THE COLLECTION OF MANURE FROM HOUSED LIVESTOCK KEYWORDS DAIRY-CATTLE SLATTED-FLOORS OX
100 68 1229	DAIRY-CATTLE	ANAEROBIC LAGOON TREATMENT OF MILKING PARLOR WASTES KEYWORDS ANAEROBIC-CONDITIONS INDUS
200 69 0188	DAIRY-CATTLE	PROBLEMS AND PRACTICES IN SOME SYSTEMS OF MANURE HANDLING IN NORTHERN EUROPE KEYWORDS
300 70 0384	DAIRY-CATTLE	THE ECONOMICS OF CLEAN WATER VOLUME TWO ANIMAL WASTES PROFILE KEYWORDS COSTS WATER-PO
400 65 0332	DAIRY-CATTLE	HOW WE HANDLE LIQUID-MANURE KEYWORDS DAIRY-CATTLE SLURRY STORAGE-TANKS AGITATION VOL
400 70 0357	DAIRY-CATTLE	FROM THE ALS MECHANICAL-CLEANING OF COWSHEDS KEYWORDS DAIRY-CATTLE AGE COSTS SPECIFIC
100 68 1229	DAIRY-INDUSTRY	ANAEROBIC LAGOON TREATMENT OF MILKING PARLOR WASTES KEYWORDS ANAEROBIC-CONDITIONS INDUS
100 70 1040	DAIRY-INDUSTRY	STABILIZATION OF DAIRY WASTES BY ALGAL-BACTERIAL SYMBIOSIS IN OXIDATION PONDS KEYWORDS
100 70 1090	DAIRY-INDUSTRY	COUMAPHOS AS A FEED ADDITIVE FOR THE CONTROL OF HOUSE FLY LARVAE IN COW MANURE KEYWORDS
100 70 1227	DAIRY-INDUSTRY	AGRICULTURAL LIVESTOCK WASTES LITERATURE REVIEW KEYWORDS AGRICULTURE INDUSTRIAL-WASTES
100 71 1214	DAIRY-INDUSTRY	THE DISPOSAL OF AGRICULTURAL WASTE KEYWORDS WASTE-DISPOSAL FARM-WASTES WATER-POLLUTION
100 72 1193	DAIRY-INDUSTRY	CHARACTERISTICS OF MILKING CENTER WASTE EFFLUENT FROM NEW YORK STATE DAIRY FARMS KEYWOR
100 73 1087	DAIRY-INDUSTRY	ENRICHMENT OF THE ATMOSPHERE WITH NITROGEN COMPOUNDS VOLATILIZED FROM A LARGE DAIRY ARE
200 68 1187	DAIRY-INDUSTRY	THE MANAGEMENT AND DISPOSAL OF DAIRY MANURE KEYWORDS FARM-WASTES MANAGEMENT FARM-MANAGE
200 70 0755	DAIRY-INDUSTRY	FEEDLOT WASTE IN FLORIDA KEYWORD WASTE-TREATMENT BIOLOGICAL-TREATMENT WASTE-DISPOSAL
200 71 0604	DAIRY-INDUSTRY	STATUS OF DAIRY CATTLE WASTE TREATMENT AND MANAGEMENT RESEARCH KEYWORDS DAIRY-INDUSTR
200 71 1095	DAIRY-INDUSTRY	BIOLOGICAL ASPECTS OF AGRICULTURES EFFECTS ON ENVIRONMENTAL QUALITY KEYWORDS
300 46 1208	DAIRY-INDUSTRY	GREEN V MCCLOUD ACTION TO ENJOIN SEWAGE FLOW KEYWORDS KENTUCKY DOMESTIC-WASTES WATER-PO
300 71 0732	DAIRY-INDUSTRY	CLOSED SYSTEMS FOR ANIMAL SEWAGE TREATMENT KEYWORD ENVIRONMENTAL-EFFECTS DAIRY-INDUST
400 73 1168	DAIRY-INDUSTRY	CALIFORNIA WASTE PONDS ARE PASSING THE TEST KEYWORDS IRRIGATION-STORAGE-PONDS LEACHING
400 73 1176	DAIRY-INDUSTRY	ODOR CONTROL MAY BE A BIG CONCERN KEYWORDS ODOR LIVESTOCK FARM-WASTES DAIRY-INDUSTRY CO
600 72 1004	DAIRY-INDUSTRY	CORRELATING OIL AND ODOROUS COMPONENTS IN STORED DAIRY MANURE KEYWORDS
600 72 1148	DAIRY-INDUSTRY	DAIRY WASTE PONDS EFFECTIVELY SELF SEALING KEYWORDS GROUNDWATER-POLLUTION FARM-WASTES I
100 65 0331	DAIRY-MANURE	DISPOSAL OF DAIRY-MANURE KEYWORDS SEPTIC-TANK AESTHETICS EFFICIENCIES RECIRCULATED-W
200 66 0135	DAIRY-MANURE	TRICKLING FILTERS AS A DAIRY-MANURE STABILIZATION COMPONENT KEYWORDS BOD LABORATORY TE
200 69 0552	DAKOTA	STATUS,PLANS,& NEEDS FOR A COMPREHENSIVE FEEDLOT POLLUTION CONTROL PROGRAM IN SOUTH DA
200 70 0054	DAKOTA	POLLUTION POTENTIAL OF LIVESTOCK FEEDING OPERATIONS IN SOUTH DAKOTA KEYWORDS LAGOONS
300 46 1207	DAMAGES	FAIRES V DUPREE WATER POLLUTION FROM ANIMAL WASTES KEYWORDS ARKANSAS HOGS ANIMAL-WASTES
300 49 1210	DAMAGES	MEASURE AND ELEMENTS OF DAMAGES FOR POLLUTION OF A STREAM KEYWORDS JUDICIAL-DECISIONS D
300 68 1202	DAMAGES	OWENS V UNITED STATES LIABILITY OF UNITED STATES FOR NEGLIGENT APPLICATION OF INSECTICI
300 68 1209	DAMAGES	ATKINSON V HERINGTON CATTLE COMPANY FEED LOT OPERATORS AND CATTLE OWNERS JOINT LIABILI
300 70 0073	DAMAGES	STOCKMEN S LIABILITY UNDER THE MISSOURI NUISANCE LAW KEYWORDS ODOR NOISE LAWSUITS DAMA
300 46 1207	DAMAGES-LEGAL-ASPE	FAIRES V DUPREE WATER POLLUTION FROM ANIMAL WASTES KEYWORDS ARKANSAS HOGS ANIMAL-WASTES
400 68 0038	DAMS	PONDS STOP POLLUTION FROM FEEDLOTS KEYWORDS PONDS KANSAS WATER-QUALITY-ACT DAMS RUNO
100 64 1200	DAPHNIA	PROGRESSIVE CHANGES IN THE CLADOCERAN AND MIDGE FAUNA DURING THE ONTOGENY OF ESTHWAITE
100 64 1200	DAPHNIIDAE	PROGRESSIVE CHANGES IN THE CLADOCERAN AND MIDGE FAUNA DURING THE ONTOGENY OF ESTHWAITE
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200 64 1241	DASYTRICHA	PHYSIOLOGY OF THE RUMEN PROTOZOA KEYWORDS RUMINANTS PROTOZOA BACTERIA CATTLE REPRODUCTI
100 71 1213	DATA	A COMPUTER PROGRAM FOR IDENTIFYING MICROORGANISMS KEYWORDS PATHOGENIC-BACTERIA ENTERIC-
300 67 0711	DATA	THE NITRATE HAZARD IN WELL WATER KEYWORDS WELL DATA FEED-LOTS WELL-REGULATIONS PERCOL
600 71 0272	DATA	A DOSING-SIPHON FOR DISCHARGING CLEANING-WATER INTO FLUSHING-GUTTERS KEYWORDS DESIGN
100 71 1039	DATA-COLLECTIONS	NUTRIENTS IN STREAMS DRAINING WOODLAND AND FARMLAND NEAR COSHOCTON OHIO KEYWORDS
200 66 1112	DATA-COLLECTION	CATTLE FEEDLOT RUNOFF NATURE AND BEHAVIOR KEYWORDS WATER-POLLUTION-SOURCES SURFACE-RUNO
300 72 1052	DATA-COLLECTIONS	EFFECT OF ANIMAL WASTES APPLIED TO SOILS ON SURFACE AND GROUNDWATER SYSTEMS KEYWORDS
100 72 1222	DATA-INTERPRETATIO	PEPSIN DIGESTIBILITY METHOD FOR ANIMAL PROTEINS KEYWORDS DIGESTION FILTRATION ANALYTICA
100 71 1213	DATA-PROCEDDING	A COMPUTER PROGRAM FOR IDENTIFYING MICROORGANISMS KEYWORDS PATHOGENIC-BACTERIA ENTERIC-
100 62 1220	DDT	WATER POLLUTION RESULTING FROM AGRICULTURAL ACTIVITIES KEYWORDS WATER-POLLUTION-SOURCES
100 70 1111	DDT	POLYCHLORINATED BIPHENYLS KEYWORDS CHLORINATED-HYDROCARBON-PESTICIDES FOOD-CHAINS PESTI
200 71 0276	DDT	THE SPORTSMANS VIEW KEYWORDS PESTICIDES DDT BIO[illegible]TROL BENEFICIAL-USE TOXICITY BIOLOG
200 71 0280	DDT	PESTICIDES KEYWORDS DDT HAZARDS BENEFICIAL-USE [illegible]TH PESTICIDES
200 71 1094	DDT	AGRICULTURE AND POLLUTION--SOCIO-ECONOMIC ASPECT[illegible]WORDS WATER-POLLUTION ECONOMICS SU
300 72 1260	DDT	NONPOINT RURAL SOURCES OF WATER POLLUTION KEYWORD[illegible]TER POLLUTION RURAL AREAS FERTILIZ
400 71 0293	DDT	SODIUM EGG-SHELLS EFF-QUALITY EGG-PRODUCTION ALBUMEN SOUTHERN WORKERS REPORT RESEARCH K
400 71 0315	DDT	IF COW MANURE BREAKS DOWN DDT KEYWORDS COW DDT
500 70 0395	DDT	CHEMISTRY AND METABOLISM OF INSECTICIDES KEYWORDS ALDRIN DDT DIELDRIN INSECT-CONTROL
500 70 0396	DDT	THE PESTICIDE BURDEN IN WATER AND ITS SIGNIFICANCE KEYWORDS DDT SOURCES CONCENTRATION
200 69 0523	DEAD-ANIMAL-DISPOS	DEAD-ANIMALS AND HOW THEY CONTRIBUTE TO POLLUTION OF THE ENVIRONMENT KEYWORDS DEAD-AN
300 72 1157	DEAD-BIRD-DISPOSAL	CANADA ANIMAL WASTE MANAGEMENT GUIDE KEYWORDS FARM-WASTES LIVESTOCK PRODUCTION DESIGN M
200 72 1015	DEBRIS-BASIN	DESIGN AND MANAGEMENT OF RUNOFF CONTROL SYSTEMS KEYWORDS FARM-WASTES FEED-LOTS CATTLE R
200 70 1050	DECISION-MAKING	THE LEGAL FUTURE NEW THEORIES OF ENVIRONMENTAL PROTECTION KEYWORDS ENVIRONMENTAL-SANI
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400 65 0439	DECOMPOSING	THE DECOMPOSITION OF URIC ACID IN BUILT UP POULTRY LITTER KEYWORDS DECOMPOSING ORGANIC
200 71 1252	DECOMPOSING-ORGANI	NITRATE POLLUTION OF WATER KEYWORDS WATER-POLLUTION-SOURCES GROUNDWATER SURFACE-WATERS
300 46 1208	DECOMPOSING-ORGANI	GREEN V MCCLOUD ACTION TO ENJOIN SEWAGE FLOW KEYWORDS KENTUCKY DOMESTIC-WASTES WATER-PO
700 71 1120	DECOMPOSING-ORGANI	SOURCES OF PHOSPHATE AMMONIUM AND NITRATE CONTAMINATION IN SOME CENTRAL NEW JERSEY STR
200 71 0809	DECOMPOSITION	ENZYME FACILITATED MICROBIAL DECOMPOSITION OF CATTLE FEEDLOTMANURE KEYWORDS BOD AMINO
300 71 0514	DECOMPOSITION	FECAL RESIDUES FROM HORMONES AND ANTIBIOTICS--BEEF CATTLE KEYWORDS DECOMPOSITION DISE
400 71 0305	DECOMPOSITION	RETARDING EFFECT OF DESSICATION ON NITROGEN MINERALIZATION IN ORGANIC MANURES KEYWORDS
500 70 0400	DECOMPOSITION	MANURE DECOMPOSITION AND FATE OF BREAKDOWN PRODUCTS IN SOILS KEYWORDS DISPOSAL FERTIL
500 70 0401	DECOMPOSITION	MANURE TRANSFORMATIONS AND FATE OF DECOMPOSITION PRODUCTS IN WATER KEYWORDS DISPOSAL M
200 71 0828	DEEP-TILLAGE	DISPOSAL OF BEEF MANURE BY DEEP PLOWING KEYWORDS DEEP-TILLAGE COST-COMPARISONS CROP-P
300 64 1110	DEFINITIONS	LAKE TERMINOLOGY WATER BLOOM KEYWORDS EUTROPHICATION ALGAE DUCKS COLOR FISHKILL LAKES
100 64 1200	DEFORESTATION	PROGRESSIVE CHANGES IN THE CLADOCERAN AND MIDGE FAUNA DURING THE ONTOGENY OF ESTHWAITE
100 66 0063	DEGRADATION	SOIL POLLUTANTS THEIR ORIGIN AND BEHAVIOR KEYWORDS PESTICIDES SEWAGE DEGRADATION RAD
100 67 0501	DEGRADATION	INVESTIGATIONS ON FLY-CONTROL BY COMPOSTING POULTRY-MANURES KEYWORDS TEMPERATURE DEGRA
200 68 0587	DEGRADATION	HYDROGEN SULFIDE AND METHYL MERCAPTANS REMOVALS WITH SOIL COLUMNS KEYWORDS DEGRADATIO
200 72 1023	DEGRADATION	CHARACTERISTICS OF LIVESTOCK WASTE AND RUNOFF KEYWORDS FARM-WASTES PHYSICAL-PROPERTIES
600 72 1156	DEGRADATION-DECOMP	SEEPAGE LOSSES AND FERTILIZER PRESERVATION IN MANURE STACKING PRACTICE KEYWORDS
300 71 0629	DEHYDRATED-FECES	THE EFFECTS OF CONTINUALLY RECYCLING DEHYDRATED POULTRY WASTES DPW ON THE PERFORMANCE
100 70 0020	DEHYDRATED-POULTRY	EFFECT OF DIETS CONTAINING DEHYDRATED POULTRY WASTE ON QUALITY CHANGES IN SHELL EGGS DU
200 71 0848	DEHYDRATED-POULTRY	DEHYDRATED POULTRY WASTE DPW AS A FEEDSTUFF IN POULTRY RATIONS KEYWORD RECYCLING NU
300 70 0211	DEHYDRATED-POULTRY	THE EFFECT OF FEEDING DEHYDRATED-POULTRY-WASTE ON PRODUCTION, FEED-EFFICIENCY, BODY-WEI
400 71 0504	DEHYDRATING-POULTR	COST OF DEHYDRATING POULTRY MANURE KEYWORDS SHELF-LIFE FERTILIZERS EQUIPMENT COST DEH
100 65 0470	DEHYDRATION	CONTROLLING ODORS FROM CATTLE FEEDLOTS AND MANURE DEHYDRATION OPERATIONS KEYWORDS LEG
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200 69 0055	DEHYDRATION	MISSION IMPOSSIBLE DISPOSAL ANIMAL WASTES KEYWORDS PRODUCTION TRANSPORTATION MANAGEM
200 69 0186	DEHYDRATION	MANURE CONSERVATION KEYWORDS POULTRY FERTILIZER POTASH AIR-CONDITIONING GROSS-PROFIT
200 70 0715	DEHYDRATION	OVERALL PROBLEMS AND AN APPROACH TO DISPOSAL OF ANIMAL WASTE KEYWORDS DEHYDRATION FORC
200 71 0651	DEHYDRATION	ANIMAL WASTE HANDLING IN THE UNITED KINGDOM KEYWORDS REUSE DEHYDRATION WASTE-TREATMEN
200 71 0658	DEHYDRATION	MOISTURE REMOVAL KEYWORDS DRYING DEHYDRATION ABSORPTION WASTE-STORAGE INCINERATION RE
200 71 0768	DEHYDRATION	SYSTEMS FOR THE DEHYDRATION OF LIVESTOCK WASTES A TECHNICAL AND ECONOMICAL REVIEW KEY
200 71 0783	DEHYDRATION	SOLVING THE POULTRY MANURE PROBLEM ECONOMICALLY THROUGH DEHYDRATION KEYWORDS ODOR DRY
200 71 1096	DEHYDRATION	ENGINEERING AGRICULTURAL WASTES KEYWORDS DEHYDRATION LAND-USE PROTEINS EROSION TECHNOLO
300 70 0204	DEHYDRATION	POULTRY POLLUTION PROBLEMS AND SOLUTIONS KEYWORDS EGGS DEHYDRATION FEED DIET ODOR CO
300 70 0209	DEHYDRATION	THE UTILIZATION OF POULTRY-WASTE AS A FEEDSTUFF FOR GROWING CHICKS KEYWORDS DEHYDRATI

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300 71 0628  DEHYDRATION        THE METABOLIZEABLE ENERGY VALUE OF DRIED POULTRY WASTE  KEYWORDS  NUTRIENT DEHYDRATION
300 71 0630  DEHYDRATION        A COMPILATION OF SOME SAMPLES OF DRIED POULTRY WASTE ANALYZED BY DR  E  J  BENNE  KEYWO
300 71 1106  DEHYDRATION        MANAGING OUR ENVIRONMENT KEYWORDS MANAGEMENT ENVIRONMENT AGRICULTURE WATER-POLLUTION-CO
300 72 1157  DEHYDRATION        CANADA ANIMAL WASTE MANAGEMENT GUIDE KEYWORDS FARM-WASTES LIVESTOCK PRODUCTION DESIGN M
300 72 1182  DEHYDRATION        BACTERIOLOGICAL PROCEDURES FOR ANALYZING WET AND DRIED POULTRY FECES KEYWORDS
400 71 0313  DEHYDRATION        TYPES OF MANURE DRYERS  KEYWORDS  DEHYDRATION EQUIPMENT
600 71 0497  DEHYDRATION        DEHYDRATION OF ANIMAL WASTES KEYWORDS FARM-WASTES DEHYDRATION FERTILIZERS
300 53 1206  DELAWARE           POLLUTION OF STREAMS KEYWORDS DELAWARE WATER-POLLUTION STREAMS SOURCES
700 70 1046  DELAWARE           AN ECONOMIC ANALYSIS OF POULTRY PROCESSING WASTEWATER IN DELAWARE AND APPROPRIATE MUNIC
100 65 0263  DEMAND             REMOVAL OF PLANT NUTRIENTS BY MEANS OF AEROBIC STABILIZATION OF SLUDGE  KEYWORDS WASTE
100 66 0437  DEMAND             PROPERTIES OF FARM ANIMAL EXCRETA  KEYWORDS  LIVESTOCK GASES BIODEGRADATION BIOCHEMICAL
100 71 0304  DEMAND             STATE OF THE ART REVIEW  TREATMENT AND DISPOSAL OF SWINE WASTES  KEYWORDS  CHEMICAL OXY
200 71 0787  DEMAND             IMPACT OF FARM ANIMAL PRODUCTION AND PROCESSING ON THE TOTAL ENVIRONMENT  KEYWORDS  SOI
300 72 1065  DEMAND             CHARACTERISTICS OF RAINFALL RUNOFF FROM A BEEF CATTLE FEEDLOT KEYWORDS
300 70 0492  DEMINERALIZATION   DISTILLATION OF WASTEWATERS  A WATER-RESOURCE FOR ARID-REGIONS  KEYWORDS  EFFLUENT-REUS
100 65 0263  DENITRIFICATION    REMOVAL OF PLANT NUTRIENTS BY MEANS OF AEROBIC STABILIZATION OF SLUDGE  KEYWORDS WASTE
100 65 1219  DENITRIFICATION    NITRATES IN THE ENVIROMENT KEYWORDS NITROGEN  ATMOSPHERE BIOSPHERE FERTILIZATION NITROG
100 70 0021  DENITRIFICATION    EFFECT OF MANURE APPLICATION, AERATION, AND SOIL PH ON SOIL NITROGEN TRANSFORMATIONS AN
100 70 0050  DENITRIFICATION    TREATMENT AND DISPOSAL OF ANIMAL WASTES  KEYWORDS  LAGOONS  NUTRIENTS CONFINEMENT HOLDI
200 69 0179  DENITRIFICATION    CHANGES IN COMPOSITION OF CONTINUOUSLY AERATED POULTRY MANURE WITH SPECIAL REFERENCE TO
200 70 0218  DENITRIFICATION    REDUCING THE POLLUTION POTENTIAL OF LIVESTOCK WASTES WITH IN-THE-BUILDING OXIDATION DIT
200 70 0727  DENITRIFICATION    EFFECTS OF AGRICULTURAL DISCHARGES INTO FRESH WATER LAKES  KEYWORD  DRAINAGE-EFFECTS DE
200 70 0737  DENITRIFICATION    REDUCTION OF NITROGEN CONCENTRATIONS IN SWINE LAGOON EFFLUENT BY BIOLOGICAL DENITRIFICA
200 71 0818  DENITRIFICATION    THE ECONOMICS OF SWINE WASTE DISPOSAL  KEYWORDS  COSTS ECONOMIC-FEASIBILITY AEROBIC-TRE
200 71 0824  DENITRIFICATION    AEROBIC TREATMENT OF LIQUID AND SOLID POULTRY MANURE  KEYWORDS  BIODEGRADATION NITRIFIC
200 71 0827  DENITRIFICATION    A BARRIERED LANDSCAPE WATER RENOVATION SYSTEM FOR REMOVING PHOSPHATE AND NITROGEN FROM
200 71 0830  DENITRIFICATION    FATE OF INORGANIC FORMS OF N AND SALT FROM LAND-DISPOSED MANURES FROM DAIRIES  KEYWORDS
200 71 0838  DENITRIFICATION    NITROGEN TRANSFORMATION DURING AEROBIC DIGESTION AND DENITRIFICATION OF DAIRY CATTLE WA
200 71 0839  DENITRIFICATION    AEROBIC BIOLOGICAL BREAKDOWN OF FARM WASTE  KEYWORD  DENITRIFICATION ACTIVATED-SLUDGE C
200 71 1033  DENITRIFICATION    NITROGEN IN INDUSTRY KEYWORDS NITROGEN INDUSTRY FERTILIZERS WATER-POLLUTION AMMONIA FAR
300 70 0487  DENITRIFICATION    NITRATE-REMOVAL FROM AGRICULTURAL WASTEWATER  KEYWORDS ALGAE CALIFORNIA DENITRIFICATION
300 71 0639  DENITRIFICATION    USING SOIL FILTRATION TO REDUCE POLLUTION POTENTIAL OF LAGOON EFFLUENT ENTERING GROUNDW
300 71 1058  DENITRIFICATION    DEVELOPMENT OF A MATHEMETICAL MODEL TO PREDICT THE ROLE OF  SURFACE RUNOFF AND GROUNDWA
400 69 0016  DENITRIFICATION    FERTILIZERS AND FEEDLOTS - WHAT ROLE IN GROUNDWATER POLLUTION  KEYWORDS  FERTILIZERS SO
400 73 1073  DENITRIFICATION    NITRATE CONTENT OF PERCOLATES FROM MANURED LYSIMETERS KEYWORDS NITRATES FARM-WASTES LYS
400 73 1181  DENITRIFICATION-CO SALMON THAT NEED NEVER SEE THE SEA KEYWORDS RECIRCULATED-WATER SALMON RHODE-ISLAND
600 69 1239  DENITRIFICATION    DRAIN INSTALLATION FOR NITRATE REDUCTION KEYWORDS CALIFORNIA DRAINS INSTALLATION NITRAT
700 70 1256  DENITRIFICATION    MOVEMENT OF POLLUTANT PHOSPHORUS IN SATURATED SOILS KEYWORDS PHOSPHATES SOIL-CONTAMINAT
700 72 1048  DENITRIFICATION    SPRINKLER APPLICATION OF ANAEROBICALLY TREATED SWINE WASTES AS LIMITED BY NITROGEN CONC
300 70 0208  DENSITY            DRYING ANIMAL WASTE  KEYWORDS POULTRY CATTLE HOGS MOISTURE-CONTENT NUTRIENTS DENSITY CO
600 73 1075  DENSITY            THE EFFECT OF RATION ON ENGINEERING PROPERTIES OF BEEF CATTLE MANURE KEYWORDS
100 71 1228  DENTRIFICATION     ALTERNATIVES FOR THE TREATMENT AND DISPOSAL OF ANIMAL WASTES  KEYWORDS FARM-WASTES DISP
200 70 1115  DENTRIFICATION     CONTROL OF NITROGEN FROM ANIMAL WASTE WATERS KEYWORDS FARM-WASTES NITROGEN-COMPOUNDS WA
300 68 1122  DENTRIFICATION     NITROGEN CYCLE IN SURFACE AND SUBSURFACE WATERS KEYWORDS DOMESTIC-ANIMALS WASTES FERTIL
300 68 0741  DENVER             RULES AND GUIDELINES FOR THE CONTROL OF WATER POLLUTION FROMLIVESTOCK CONFINEMENT FACIL
100 70 0019  DEODORANTS         CONTROL OF ODORS FROM ANIMAL WASTES KEYWORDS CHEMICALS COST ODOR-PANEL MASKING-AGENTS D
200 69 0482  DEOXYGENATION      THE EFFECTS OF FARM WASTES ON THE POLLUTION OF NATURAL WATERS  KEYWORD  GROUNDWATER NUT
200 72 1018  DEPARTMENT-OF-ENVI EDUCATION ACTION AND REGULATORY PROBLEMS OF ANIMAL WASTE MANAGEMENT KEYWORDS
200 72 1019  DEPARTMENT-OF-ENVI PROBLEMS OF ANIMAL WASTE MANAGEMENT FROM THE LIVESTOCK FEEDER VIEWPOINT KEYWORDS
300 49 1210  DEPRECIATION       MEASURE AND ELEMENTS OF DAMAGES FOR POLLUTION OF A STREAM KEYWORDS JUDICIAL-DECISIONS D
300 68 0741  DEPT               RULES AND GUIDELINES FOR THE CONTROL OF WATER POLLUTION FROMLIVESTOCK CONFINEMENT FACIL
100 70 0094  DEPTH              THE INFLUENCE OF AERATION ON THE COMPOSTING OF POULTRY MANURE-GROUND CORNCOB MIXTURES
300 69 0002  DEPTH              SWINE WASTE MANAGEMENT-ANAEROBIC LAGOONS-FACT SHEET  KEYWORDS  SIZE LOCATION SHAPE DEPT
300 70 0488  DESALINATION       THE EFFECTS OF SALINITY-STANDARDS ON IRRIGATED-AGRICULTURE  IN THE COLORADO-RIVER-BASIN
100 68 0500  DESIGN             ANAEROBIC LAGOONS CONSIDERATIONS IN DESIGN AND APPLICATION  KEYWORDS FARM-LAGOONS ANAER
100 70 0458  DESIGN             USE OF SOIL TO TREAT ANAEROBIC LAGOON EFFLUENT  DESIGN AND OPERATION OF A FIELD DISPOSA
100 71 0582  DESIGN             CRITERIA NEEDED TO DESIGN ANIMAL QUARTERS FOR COMFORT AND PRODUCTIVITY  KEYWORDS  AIR-C
100 71 0721  DESIGN             HOW ENVIRONMENTAL PROBLEMS AFFECT FARM EQUIPMENT DESIGN  KEYWORD  FERTILIZER ODOR RUNOF
100 71 0729  DESIGN             DESIGN AND OPERATION OF A PILOT PLANT FOR COMPOSTING POULTRY MANURE  KEYWORD  ODOR WAST
200 66 0138  DESIGN             DESIGN CRITERIA FOR ANAEROBIC LAGOONS FOR SWINE MANURE DISPOSAL  KEYWORDS  COD BOD TEMP
200 69 0163  DESIGN             DESIGN PARAMETERS FOR THE STABILIZATION OF HIGHLY ORGANIC MANURE SLURRIES BY AERATION
200 69 0183  DESIGN             THE EFFECT OF FEED, DESIGN, AND MANAGEMENT ON THE CONTROL OF POLLUTION FROM BEEF CATTLE
200 69 0428  DESIGN             DESIGN FOR FEEDLOT WASTE MANAGEMENT - HISTORY AND CHARACTERISTICS  KEYWORDS  RAINFALL-R
200 70 0219  DESIGN             THE CONCEPTUAL DESIGN OF AN ECONOMICALLY FEASIBLE ANIMAL WASTE DISPOSAL SCHEME  KEYWORD
200 70 0244  DESIGN             MINIMIZING THE WASTE PROBLEM WITH PIGS  KEYWORDS  SLURRIES  SWINE ODOR CONFINEMENT-PENS
200 70 0246  DESIGN             BUILDING DESIGN  KEYWORDS  MANAGEMENT COSTS DESIGN GASES DISPOSAL LAGOONS BUILDINGS STO
200 70 0247  DESIGN             BUILDING DESIGN AND MANURE DISPOSAL  KEYWORDS  STORAGE SLURRIES DISPOSAL DESIGN-CRITERI
200 70 0248  DESIGN             PIGGERY CLEANING USING RENOVATED WASTES  KEYWORDS  DISPOSAL EQUIPMENT OXIDATION-DITCH F
200 71 0597  DESIGN             STATE REGULATIONS PERTAINING TO LIVESTOCK FEEDLOT DESIGN ANDMANAGEMENT  KEYWORDS  RUNOF
200 71 0767  DESIGN             PUTTING IT ALL TOGETHER  KEYWORDS  FEDERAL-GOVERNMENTS STATE-GOVERNMENTS BUDGETING DESI
200 71 0822  DESIGN             DESIGN, INSTALLATION AND BIOLOGICAL ASSESSMENT OF A PASVEER OXIDATION DITCH ON A LARGE
300 69 0006  DESIGN             SWINE WASTE MANAGEMENT-OXIDATION DITCH FOR TREATING HOG WASTES-FACT SHEET  KEYWORDS  DE
300 71 0590  DESIGN             THE MISSOURI APPROACH TO ANIMAL WASTE MANAGEMENT  KEYWORDS  LAGOONS DESIGN IRRIGATION M
300 72 1157  DESIGN             CANADA ANIMAL WASTE MANAGEMENT GUIDE KEYWORDS FARM-WASTES LIVESTOCK PRODUCTION DESIGN M
600 69 1005  DESIGN             FACILITY DESIGN KEYWORDS FEED-LOTS RUNOFF WATER-POLLUTION-CONTROL DESIGN FARM-WASTES
600 71 0272  DESIGN             A DOSING-SIPHON FOR DISCHARGING CLEANING-WATER INTO FLUSHING-GUTTERS  KEYWORDS  DESIGN
100 62 0499  DESIGN-CRITERIA    MANURE LAGOONS DESIGN CRITERIA AND MANAGEMENT  KEYWORDS FARM-LAGOONS DESIGN-CRITERIA SI
100 65 0366  DESIGN-CRITERIA    LIQUID HANDLING OF POULTRY MANURE  KEYWORDS  SLUDGE ODOR DISPOSAL DESIGN-CRITERIA RECYC
100 69 0353  DESIGN-CRITERIA    OXIDATION-DITCH TREATMENT OF SWINE WASTES  KEYWORDS  SLURRIES HOD COD ODORS EQUIPMENT L
100 71 0266  DESIGN-CRITERIA    CAGED LAYER PERFORMANCE IN PENS WITH OXIDATION DITCHES AND  LIQUID MANURE STORAGE TANKS
100 71 1232  DESIGN-CRITERIA    WASTE WATER FROM SIMIAN PRIMATE FACILITIES KEYWORDS LABORATORY-ANIMALS WASTE-WATER-TREA
200 69 0756  DESIGN-CRITERIA    SWINE-WASTE MANAGEMENT  KEYWORDS  LEGAL-ASPECTS DESIGN-CRITERIA HOGS ODOR TREATMENT FAC
200 70 0241  DESIGN-CRITERIA    SEWERS AND SEWAGE TREATMENT  KEYWORDS  LEGISLATION DESIGN-CRITERIA ACTIVATED-SLUDGE CAP
200 70 0247  DESIGN-CRITERIA    BUILDING DESIGN AND MANURE DISPOSAL  KEYWORDS  STORAGE SLURRIES DISPOSAL DESIGN-CRITERI
200 70 0747  DESIGN-CRITERIA    ALTERNATIVES IN CATTLE FEEDLOT WASTE MANAGEMENT  KEYWORD  WASTE-TREATMENT DESIGN-CRITER
200 70 1113  DESIGN-CRITERIA    AERATED LAGOON TREATMENT OF LONG ISLAND DUCK WASTES KEYWORDS OXIDATION-LAGOONS FARM-WAS
200 71 0733  DESIGN-CRITERIA    ALTERNATIVES FOR WASTE MANAGEMENT FOR OPEN BEEF FEEDLOTS  KEYWORD  RUNOFF SOLID-WASTES
200 71 0740  DESIGN-CRITERIA    PHOTOGRAPHIC STUDIES OF THE DUNGING BEHAVIOR OF PIGS IN CONFINEMENT  KEYWORD  ANIMAL-BE
300 71 0486  DESIGN-CRITERIA    FARM ANIMAL-WASTE MANAGEMENT  KEYWORDS  DISPOSAL DESIGN-CRITERIA DISEASES OXIDATION-DIT
300 71 0752  DESIGN-CRITERIA    ROLE OF THE SOIL CONSERVATION SERVICE IN DESIGN OF FEEDLOT WASTE MANAGEMENT FACILITIES
300 72 1003  DESIGN-CRITERIA    CATTLE FEEDLOTS AND THE ENVIRONMENT KEYWORDS FEED-LOTS DESIGN-CRITERIA AIR-POLLUTION WA
400 70 0092  DESIGN-CRITERIA    SEEK DATA IN FEEDLOT RESEARCH  KEYWORDS  SOUTH-DAKOTA FEEDLOT DESIGN-CRITERIA HOD CATTL
500 68 1259  DESIGN-CRITERIA    WASTE STABILIZATION PONDS FOR AGRICULTURAL WASTES KEYWORDS WASTE-TREATMENT STABILIZATIO
500 70 0401  DESIGN-CRITERIA    MANURE TRANSFORMATIONS AND FATE OF DECOMPOSITION PRODUCTS IN WATER KEYWORDS  DISPOSAL M
200 69 0423  DESIGN-DATA        2ND COMPENDIUM OF ANIMAL WASTE MANAGEMENT KEYWORDS  RAINFALL-RUNOFF EQUIPMENT DESIGN-D
200 70 0252  DESIGN-DATA        ANAEROBIC TREATMENT OF FARM WASTES  KEYWORDS  BACTERIA SLUDGE SLURRIES DESIGN-DATA METH
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100 67 0079  DETERGENTS          SOURCES OF NITROGEN AND PHOSPHORUS IN WATER SUPPLIES  KEYWORDS DISTRIBUTION FERTILIZERS
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200 70 0237	DISPOSAL	THE PROBLEM OF DISPOSAL OF FARM WASTES WITH PARTICULAR REFERENCE TO MAINTAINING SOIL F
200 70 0237	DISPOSAL	THE PROBLEM OF DISPOSAL OF FARM WASTES WITH PARTICULAR REFERENCE TO MAINTAINING SOIL F
200 70 0240	DISPOSAL	WATER POLLUTION PREVENTION REQUIREMENTS IN RELATION TO FARM-WASTE DISPOSAL KEYWORDS L
200 70 0242	DISPOSAL	MINIMIZING THE WASTE DISPOSAL PROBLEM IN VEGETABLE PROCESSING KEYWORDS COD BOD REVERS
200 70 0243	DISPOSAL	MINIMIZING POULTRY WASTE PROBLEMS KEYWORDS COSTS DISPOSAL ODOR BOD UK FERTILIZERS SLU
200 70 0245	DISPOSAL	MINIMIZING THE WASTE PROBLEM WITH CATTLE KEYWORDS SLURRIES DISPOSAL COSTS CONFINEMENT
200 70 0246	DISPOSAL	BUILDING DESIGN KEYWORDS MANAGEMENT COSTS DESIGN GASES DISPOSAL LAGOONS BUILDINGS STO
200 70 0247	DISPOSAL	BUILDING DESIGN AND MANURE DISPOSAL KEYWORDS STORAGE SLURRIES DISPOSAL DESIGN-CRITERI
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200 70 0249	DISPOSAL	LAND DISPOSAL AND STORAGE OF FARM WASTES 1 PLANNING AND CHOICE OF SYSTEM KEYWORDS EF
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200 70 0253	DISPOSAL	TREATMENT OF FARM WASTES KEYWORDS DISPOSAL LAGOON AERATION ACTIVATED SLUDGE SLURRIES
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200 70 0324	DISPOSAL	DISPOSAL OF SOLID AGRICULTURAL-WASTES - CONCEPTS AND PRINCIPLES KEYWORDS RESEARCH-NEE
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200 71 0614	DISPOSAL	SMALL BUSINESS ADMINISTRATION PROGRAMS TO PROVIDE FINANCIAL AND TECHNICAL ASSISTANCE TO
200 71 0640	DISPOSAL	HANDLING LIVESTOCK WASTE KEYWORDS TREATMENT OXIDATION-LAGOONS DISPOSAL DRYING SEPARAT
200 71 0649	DISPOSAL	LAND DISPOSAL OF MANURE IN RELATION TO WATER QUALITY KEYWORDS FERTILIZATION SURFACE-R
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200 71 0733	DISPOSAL	ALTERNATIVES FOR WASTE MANAGEMENT FOR OPEN BEEF FEEDLOTS KEYWORD RUNOFF SOLID-WASTES
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200 71 0784	DISPOSAL	A FARM SCALE DAIRY WASTE DISPOSAL SYSTEM KEYWORDS CATTLE SPRINKLER-IRRIGATION CONFINE

200 71 0826	DISPOSAL	CROP PRODUCTION AND SOIL ANALYSIS AS AFFECTED BY APPLICATIONS OF CATTLE FEEDLOT WASTE
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300 68 0352	DISPOSAL	DISPOSAL OF WASTES FROM SWINE FEEDING FLOORS TO MINIMIZE STREAM POLLUTION KEYWORDS SE
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400 69 0039	DISPOSAL	LABOR FREE MANURE DISPOSAL KEYWORDS FLOATING-AERATOR ODOR LAGOON AEROBIC-BACTERIA SPRI
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400 71 0339	DISPOSAL	FLUSHING AWAY MANURE PROBLEMS KEYWORDS RECIRCULATED WATER HOGS OXIDATION-DITCH FLUSHI
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300 70 0492	DISTILLATION	DISTILLATION OF WASTEWATERS A WATER-RESOURCE FOR ARID-REGIONS KEYWORDS EFFLUENT-REUS
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100 67 0079	DISTRIBUTION	SOURCES OF NITROGEN AND PHOSPHORUS IN WATER SUPPLIES KEYWORDS DISTRIBUTION FERTILIZERS
100 69 0081	DISTRIBUTION	DISTRIBUTION OF ARSENIC FROM POULTRY-LITTER IN BROILER-CHICKENS, SOIL, AND CROPS KEYWO
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300 70 0491	EUTROPHICATION	WATER-QUALITY CONTROL PROBLEMS IN INLAND-SINKS KEYWORDS SALINITY EUTROPHICATION PYRAMI
300 70 0592	EUTROPHICATION	PLANT NUTRIENTS AND ANIMAL WASTE DISPOSAL KEYWORDS ENVIRONMENTAL-EFFECTS PUBLIC-HEALT
300 70 1036	EUTROPHICATION	AGRICULTURE THE UNSEEN FOE IN THE WAR ON POLLUTION KEYWORDS AGRICULTURE WATER-POLLUTIO
300 71 0591	EUTROPHICATION	AGRICULTURAL POLLUTION OF THE GREAT LAKES BASIN KEYWORDS RUNOFF PESTICIDES EUTROPHICAT
300 71 1055	EUTROPHICATION	ANNUAL REPORT OF ACTIVITIES DURING FISCAL YEAR 1971 KEYWORDS WATER-RESOURCES WATER-USER
300 71 1107	EUTROPHICATION	WATER POLLUTION CONTROL LEGISLATION AGRICULTURAL RUNOFF PART 6 KEYWORDS AGRICULTURAL-C
400 67 1226	EUTROPHICATION	PHOSPHORUS & WATER POLLUTION KEYWORDS PHOSPHORUS GROUNDWATER WATER-POLLUTION-SOURCES SE
400 69 1045	EUTFOPHICATION	AGRICULTURES CONTRIBUTION TO THE FERTILIZATION OF CANAL LAKE KEYWORDS EUTROPHICATION NU
400 69 1225	EUTROPHICATION	CONSERVING RESOURCES AND MAINTAINING A QUALITY ENVIRONMENT KEYWORDS WATER-RESOURCE-DEV
400 73 1063	EUTROPHICATION	AGRICULTURE AND ENVIRONMENT KEYWORDS PHOTOSYNTHESIS WATER-POLLUTION NITRATES PHOSPHATES
500 70 0405	EUTROPHICATION	EFFECTS OF AGRICULTURAL-POLLUTION ON EUTROPHICATION KEYWORDS NITROGEN PHOSPHOROUS NITRA
700 71 1120	EUTROPHICATION	SOURCES OF PHOSPHATE AMMONIUM AND NITRATE CONTAMINATION IN SOME CENTRAL NEW JERSEY STR
200 66 0149	EVALUATING	EVALUATING ADAPTABILITY OF PASTURE GRASSES TO HYDROPONIC CULTURE AND THEIR ABILITY TO A
100 69 0040	EVALUATION	PHYSICAL AND BIOLOGICAL EVALUATION OF FIVE LITTER MATERIALS-ABSTRACT KEYWORDS POULTRY
100 69 0376	EVALUATION	EVALUATION OF SEVERAL METHODS OF ISOLATING SALMONELLA FROM POULTRY-LITTER AND ANIMAL-F
100 69 0714	EVALUATION	EVALUATION OF CULTURE MEDIA FOR THE ISOLATION OF SALMONELLA FROM FECES KEYWORDS
100 72 1199	EVALUATICN	IMPROVED PROCEDURES FOR THE DETERMINATION OF OXYTETRACYCLINE IN MILK MILK PRODUCTS CHIC
300 71 1056	EVALUATION	AN ANALYSIS OF THE ECONOMIC IMPLICATIONS OF THE PERMIT SYSTEM OF WATER ALLOCATION KEYWO
100 71 1232	EVAPORATION	WASTE WATER FROM SIMIAN PRIMATE FACILITIES KEYWORDS LABORATORY-ANIMALS WASTE-WATER-TREA
200 70 0224	EVAPORATION	HYDROLOGIC-STUDIES FOR EVALUATION OF THE POLLUTION-POTENTIAL OF FEEDLOTS IN EASTERN NEB
200 70 1114	EVAPORATION	ANIMAL MANURE LAGOONS A QUESTIONABLE TREATMENT SYSTEM KEYWORDS FARM-WASTES OXIDATION-LA
200 70 1118	EVAPORATION	WATER QUALITY MANAGEMENT PROBLEMS IN ARID REGIONS KEYWORDS CONFERENCES WATER-QUALITY SO
200 71 0777	EVAPORATION	FEEDLOT MANURE MANAGEMENT IN A DESERT CLIMATE KEYWORDS ODOR DUST NITROGEN LAGOON EVAP
300 68 0741	EVAPORATION	RULES AND GUIDELINES FOR THE CONTROL OF WATER POLLUTION FROMLIVESTOCK CONFINEMENT FACIL
400 70 0351	EVAPORATIVE-LAGOON	DAIRY-SET-UP FOR 200 COWS KEYWORDS LAGOON COSTS FREE-STALL-HOUSING EVAPORATIVE-LAGOON
100 69 0108	EXCRETA	EFFECTS OF FEED CONSUMPTION ON BIOCHEMICAL OXYGEN DEMAND OF STEER EXCRETA KEYWORDS SI
100 69 0361	EXCRETA	NUTRITIVE VALUE OF OXIDATION-DITCH RESIDUE KEYWORDS FEED-VALUE SWINE AEROBIC-TREATMENT
100 69 0364	EXCRETA	LOSSES OF ENERGY AND NITROGEN ON DRYING POULTRY EXCRETA KEYWORDS FREEZE-DRYING TEMPER
100 69 0693	EXCRETION	IDENTIFICATION AND EXCRETION OF ESTROGEN IN URINE DURING THE ESTROUS CYCLE OF THE EWE K
100 70 0112	MXCRETION	CURRENT TRENDS IN FARM WASTE DISPOSAL KEYWORDS NUTRIENTS EXCRETION UK ODOR POPULATION
200 66 0129	EXCRETION	WATER METABOLISM STUDIES MAY ASSIST WITH WASTE DISPOSAL KEYWORDS POULTRY ODOR CLAYS CO
300 71 0514	EXCRETION-DATA	FECAL RESIDUES FROM HORMONES AND ANTIBIOTICS--BEEF CATTLE KEYWORDS DECOMPOSITION DISE
600 72 1031	EXHAUST-FANS	ELECTRIC IN-HOUSE DRYING OF POULTRY WASTE KEYWORDS POULTRY ODOR NUTRIENTS RECYCLING FAR
200 66 0141	EXPELLED-WATER	REMOVAL OF MOISTURE FROM POULTRY WASTE BY ELECTRO-OSMOSIS PART 1 KEYWORDS DEWATERING E
200 66 0142	EXPELLED-WATER	REMOVAL OF MOISTURE FROM POULTRY WASTE BY ELECTRO-OSMOSIS PART 2 KEYWORDS DEWATERING E
200 71 0619	EXTENSION-SERVICE	REPORTS AND RECOMMENDATIONS OF WORKING GROUPS KEYWORDS ADMINISTRATIVE-AGENCIES GOVERN
500 70 0409	EXTERNALITIES	ECONOMIC-ASPECTS KEYWORDS WATER-QUALITY COSTS BENEFITS QUALITY-LEVELS EXTERNALITIES M
100 71 0464	EXTRACTION	EXTRACTION OF BILE ACIDS FROM RAT FECES CONTAINING CHOLESTYRAMINE KEYWORDS EXTRACTION
600 72 1163	EXTRACTION	ACTIVATED SLUDGE AS A SOURCE OF PROTEIN KEYWORDS BACTERIA PROTEINS AMINO-ACIDS NITROGEN
600 72 1076	EXTRUSION	HIGH-TEMPERATURE HIGH-PRESSURE EXTRUSION OF CHICKEN EXCRETA KEYWORDS FARM-WASTES POULTR
100 62 0382	E-COLI	TYPE DISTRIBUTION OF COLIFORM BACTERIA IN THE FECES OF WARM-BLOODED ANIMALS KEYWORDS
100 65 0075	E-COLI	HOG-WASTE-DISPOSAL BY LAGOONING KEYWORDS ODOR BOD COD E-COLI SAMPLING SEPTIC-TANKS ALGA
100 69 0360	E-COLI	THE BACTERIAL-POPULATION OF AN INDOOR POULTRY-LAGOON KEYWORDS E-COLI BOD MICROORGANISM
100 71 1212	E-COLI	EFFECTS OF MULTIPLE USE ON WATER QUALITY OF HIGH MOUNTAIN WATERSHEDS BACTERIOLOGICAL IN
100 71 1213	E-COLI	A COMPUTER PROGRAM FOR IDENTIFYING MICROORGANISMS KEYWORDS PATHOGENIC-BACTERIA ENTERIC-
100 72 1224	E-COLI	FACTORS AFFECTING THE CONCENTRATION OF FAECAL BACTERIA BACTERIA IN LAND DRAINAGE WATER
200 64 1240	E-COLI	THE PHYSIOLOGY OF THE COLIFORM GROUP KEYWORDS BACTERIA COLIFORMS POLLUTANTS SANITARY-E
200 70 1053	E-COLI	BACTERIOLOGICAL WATER QUALITY ANALYSES OF METHODS FOR DETECTING FECAL POLLUTION KEYWORD
200 71 0795	E-COLI	ANTIBIOTIC RESISTANCE AND RESISTANCE TRANSFER BETWEEN BACTERIAL ISOLATES IN A WASTE LAG
300 70 1104	E-COLI	FISH AS POTENTIAL VECTORS OF HUMAN BACTERIAL DISEASES KEYWORDS DISEASES VECTROS-BIOLOGY
100 71 0484	E-COLL	RELATIONSHIPS OF SALMONELLA TO FECAL COLIFORMS IN BOTTOM SEDIMENTS KEYWORD INDICATORS
200 69 0756	FACILITIES	SWINE-WASTE MANAGEMENT KEYWORDS LEGAL-ASPECTS DESIGN-CRITERIA HOGS ODOR TREATMENT FAC
400 70 0268	FACILITIES	MANURE STACKING KEYWORDS WASTE DUMPS WASTE-DISPOSAL ULTIMATE-DISPOSAL WASTE-STORAGE F
100 69 0375	FACTOR	RURAL-RUNOFF AS A FACTOR IN STREAM-POLLUTION KEYWORDS WATER-QUALITY SOIL-EROSION COLIF
400 71 0267	FACTORS	WASTE MANAGEMENT WHAT DOES IT COST KEYWORDS WASTE DISPOSAL COSTS COST ANALYSIS COST F
100 73 1155	FAECEL-LIQUOR	THE FATE OF SOLUBLE MUCIN IN THE GASTRO INTESTINAL TRACT OF SHEEP KEYWORDS
100 64 0072	FAECES	A NOTE ON THE UTILIZATION BY CHICKENS OF ENERGY FROM FAECES KEYWORDS WHEAT SORGUUM MIT
100 69 0045	FAECES	THE POTENTIAL DIGESTIBILITY OF CELLULOSE IN FORAGE AND FAECES KEYWORDS INCUBATION GRA
300 69 0004	FAILURE	CONFINEMENT SWINE HOUSING - SLOTTED FLOORS-FACT SHEET KEYWORDS MATERIALS REINFORCED-C
100 68 0306	FAILURES	ANAEROBIC DIGESTION FAILURES KEYWORDS DIGESTION SLUDGE DISPOSAL AMMONIUM ALKALINE BUIL
200 66 0148	FALLEN-STOCK	ROLE OF THE RENDERER IN THE USE AND DISPOSAL ANIMAL WASTES KEYWORDS POULTRY CATTLE EC
300 71 1106	FALLOUT	MANAGING OUR ENVIRONMENT KEYWORDS MANAGEMENT ENVIRONMENT AGRICULTURE WATER-POLLUTION-CO
200 66 0154	FAMILY-FARM	FARM-WASTE MANAGEMENT TRENDS IN NORTHERN EUROPE KEYWORDS DISPOSAL OXIDATION-PITCH FAMI
100 63 1064	FAMOPHOS	TOXICITY TO HOUSE FLIES AND HORN FLIES OF MANURE FROM INSECTICIDE FED CATTLE KEYWORDS
100 65 1091	FANNIA-CANICULARIS	TOXICITY OF DROPPINGS FROM COUMAPHOS-FED HENS TO LITTLE HOUSE FLY LARVAE KEYWORDS
600 72 1154	FANS	WINTER AND SUMMER SHELTER FOR BEEF CATTLE IN LOUISIANA KEYWORDS FEED-LOTS FARM-WASTES L
100 63 0436	FARM	POULTRY DUST ORIGIN AND COMPOSITION KEYWORDS FARM WASTES POULTRY ENVIRONMENTAL EFFEC
100 66 0437	FARM	PROPERTIES OF FARM ANIMAL EXCRETA KEYWORDS LIVESTOCK GASES BIODEGRADATION BIOCHEMICAL
100 70 0413	FARM	VALUE OF PROCESSED POULTRY WASTE AS A FEED FOR RUMINANTS KEYWORDS WASTE-TREATMENT DIG
100 70 0418	FARM	ENRICHMENT OF CATTLE MANURE FOR FEED BY ANAEROBIC FERMENTATION KEYWORDS FARM WASTES T
100 72 1097	FARM	NITRATE CONCENTRATIONS IN GROUNDWATER BENEATH A BEEF CATTLE FEEDLOT KEYWORDS
100 72 1188	FARM	IDENTIFICATION OF BEEF CATTLE FEEDLOT ODORS KEYWORDS AIR-POLLUTION ODOR CATTLE FEED-LOT
200 69 0541	FARM	FEEDLOT POLLUTION SLIDE SHOW KEYWORDS RUNOFF FISH-KILL IRRIGATION FARM LAGOONS ODOR C
200 69 0547	FARM	CONTROL DEVICES FOR ANIMAL FEEDLOT RUNOFF KEYWORDS CATTLE FARM LAGOONS IRRIGATION WAS
200 71 0819	FARM	ECONOMIC IMPLICATIONS OF ENVIRONMENTAL QUALITY LEGISLATION FOR CONFINED ANIMAL FEEDING
400 69 0419	FARM	DIGESTION OF POULTRY MANURE BY DIPTERA KEYWORDS WASTE TREATMENT WASTE DISPOSAL FARM W
400 71 1135	FARM	ENGINEER SAYS FEEDERS CAN HANDLE MOST POLLUTION CONTROL PRACTICES KEYWORDS
100 70 1195	FARMS	AGRICULTURAL POLLUTION OF WATER BODIES KEYWORDS WATER-POLLUTION FARMS LIVESTOCK PHOSPHO
100 71 1039	FARMS	NUTRIENTS IN STREAMS DRAINING WOODLAND AND FARMLAND NEAR COSHOCTON OHIO KEYWORDS
300 26 1204	FARMS	OHIO STOCK FOOD COMPANY V GINTLING STREAM POLLUTION BY UPPER RIPARIAN HOG FARM KEYWORDS
300 67 1249	FARMS	AGRICULTURAL AND RELATED WASTES CONTROL KEYWORDS WASTE-DISPOSAL KANSAS DOMESTIC-ANIMALS
300 69 1125	FARMS	ANIMAL WASTE DISPOSAL PROBLEMS AND TRENDS IN MINNESOTA KEYWORDS LIVESTOCK WASTES FARM-W
100 66 0478	FARMWASTES	LABORATORY STUDIES OF AEROBIC STABILIZATION OF SWINE WASTE KEYWORDS FARMWASTES WASTE
300 68 1043	FARM-AND-FORESTRY-	WASTES IN RELATION TO AGRICULTURE AND FORESTRY KEYWORDS SOURCES WATER-POLLUTION-EFFECTS
200 71 1033	FARM-ANIMALS	NITROGEN IN INDUSTRY KEYWORDS NITROGEN INDUSTRY FERTILIZERS WATER-POLLUTION AMMONIA FAR
400 73 1063	FARM-ANIMALS	AGRICULTURE AND ENVIRONMENT KEYWORDS PHOTOSYNTHESIS WATER-POLLUTION NITRATES PHOSPHATES
200 71 0612	FARM-CREDIT-SYSTEM	PROVIDING TECHNICAL AND FINANCIAL ASSISTANCE TO FARMERS FOR ANIMAL WASTE DISPOSAL SYSTE
400 73 1068	FARM-ECOLOGY-COMPA	NEW FEEDLOT CONCEPT USES CONVERTED MANURE AS FEED KEYWORDS RECYCLING FARM-WASTES CATTLE
100 71 1214	FARM-INCOME	THE DISPOSAL OF AGRICULTURAL WASTE KEYWORDS WASTE-DISPOSAL FARM-WASTES WATER-POLLUTION

100 62 0499	FARM-LAGOONS	MANURE LAGOONS DESIGN CRITERIA AND MANAGEMENT KEYWORDS FARM-LAGOONS DESIGN-CRITERIA SI
100 62 1220	FARM-LAGOONS	WATER POLLUTION RESULTING FROM AGRICULTURAL ACTIVITIES KEYWORDS WATER-POLLUTION-SOURCES
100 68 0580	FARM-LAGOONS	ANAEROBIC LAGOONS CONSIDERATIONS IN DESIGN AND APPLICATION KEYWORDS FARM-LAGOONS ANAER
100 73 1128	FARM-LAGOONS	USE OF DUCKWEED FOR WASTE TREATMENT AND ANIMAL FEED KEYWORDS FARM-WASTES WASTE-WATER-TR
200 70 1115	FARM-LAGOONS	CONTROL OF NITROGEN FROM ANIMAL WASTE WATERS KEYWORDS FARM-WASTES NITROGEN-COMPOUNDS WA
200 71 0655	FARM-LAGOONS	ANAEROBIC BIOLOGICAL WASTE TREATMENT SYSTEMS KEYWORDS METHANE-BACTERIA FARM-LAGOONS AN
200 71 0733	FARM-LAGOONS	ALTERNATIVES FOR WASTE MANAGEMENT FOR OPEN BEEF FEEDLOTS KEYWORD RUNOFF SOLID-WASTES
200 71 0840	FARM-LAGOONS	LOW-VOLUME, SURFACE-LAYER, AERATION-CONDITIONED MANURE STORAGE KEYWORD ODOR CATTLE FA
300 67 1253	FARM-LAGOONS	WATER QUALITY CHANGES IN CONFINED HOG WASTE TREATMENT KEYWORDS FARM-WASTES WASTE-TREATM
300 71 0697	FARM-LAGOONS	ROLE OF ANIMAL WASTES IN AGRICULTURAL LAND RUNOFF KEYWORD WATER-POLLUTION FARM-LAGOON
300 72 1157	FARM-LAGOONS	CANADA ANIMAL WASTE MANAGEMENT GUIDE KEYWORDS FARM-WASTES LIVESTOCK PRODUCTION DESIGN M
600 72 1148	FARM-LAGOONS	DAIRY WASTE PONDS EFFECTIVELY SELF SEALING KEYWORDS GROUNDWATER-POLLUTION FARM-WASTES I
100 62 1220	FARM-MANAGEMENT	WATER POLLUTION RESULTING FROM AGRICULTURAL ACTIVITIES KEYWORDS WATER-POLLUTION-SOURCES
100 71 1214	FARM-MANAGEMENT	THE DISPOSAL OF AGRICULTURAL WASTE KEYWORDS WASTE-DISPOSAL FARM-WASTES WATER-POLLUTION
200 68 1186	FARM-MANAGEMENT	TECHNICAL AND LEGAL CONTROLS FOR THE DISPOSAL OF ANIMAL WASTES KEYWORDS
200 68 1187	FARM-MANAGEMENT	THE MANAGEMENT AND DISPOSAL OF DAIRY MANURE KEYWORDS FARM-WASTES MANAGEMENT FARM-MANAGE
200 70 0670	FARM-MANAGEMENT	ALTERNATIVES FOR THE TREATMENT AND DISPOSAL OF ANIMAL WASTES KEYWORDS FARM-WASTES CON
300 68 1043	FARM-MANAGEMENT	WASTES IN RELATION TO AGRICULTURE AND FORESTRY KEYWORDS SOURCES WATER-POLLUTION-EFFECTS
300 70 1248	FARM-MANAGEMENT	LIVESTOCK INDUSTRIES IN TEXAS AS RELATED TO WATER QUALITY REPORT NUMBER ONE KEYWORDS
300 71 1035	FARM-MANAGEMENT	IMPLICATIONS OF CROP-PRODUCTION TECHNOLOGY FOR ENVIRONMENTAL QUALITY KEYWORDS
400 73 1183	FARM-MANAGEMENT	CONFINEMENT IN ARIZONA KEYWORDS FARM-MANAGEMENT FARM-WASTES CONFINEMENT-PENS FEED-LOTS
700 70 1109	FARM-MANAGEMENT	AN EVALUATION OF AN ANAEROBIC LAGOON TREATING SWINE WASTES KEYWORDS FARM-WASTES HOGS A
100 70 0042	FARM-OPERTIONS	STREAM ENRICHMENT FROM FARM OPERATIONS KEYWORDS FERTILIZER N P K NUTRIENT-LOSSES PREC
400 70 1176	FARM-PRACTICES	ANIMAL WASTE DISPOSAL KEYWORDS ANIMAL-WASTES WASTE-DISPOSAL WATER-POLLUTION NITRATES
200 71 1094	FARM-PRICES	AGRICULTURE AND POLLUTION--SOCIO-ECONOMIC ASPECTS KEYWORDS WATER-POLLUTION ECONOMICS SU
200 70 0720	FARM-WASTE	PROGRESS REPORT PASTURE FERTILIZATION USING POULTRY LITTER KEYWORDS FARM-WASTE WASTE-
200 71 0821	FARM-WASTE	AN OXIDATION DITCH FOR THE HANDLING AND TREATMENT OF POULTRY WASTES KEYWORDS FARM-WASTE
200 72 1011	FARM-WASTE	NATIONAL LIVESTOCK WASTE MANAGEMENT PROGRAM KEYWORDS FARM-WASTE FEED-LOTS GROUNDWATER R
300 68 1122	FARM-WASTE	NITROGEN CYCLE IN SURFACE AND SUBSURFACE WATERS KEYWORDS DOMESTIC-ANIMALS WASTES FERTIL
400 72 1179	FARM-WASTE	THE PRICE TAG TO STOP FEEDLOT RUN OFF KEYWORDS FARM-WASTE WASTE-DISPOSAL FEED-LOTS SETT
100 60 1078	FARM-WASTES	EXCRETION STUDIES IN SWINE FED ARSANILIC ACID KEYWORDS ARSENIC FARM-WASTES SWINE DIETS
100 62 1220	FARM-WASTES	WATER POLLUTION RESULTING FROM AGRICULTURAL ACTIVITIES KEYWORDS WATER-POLLUTION-SOURCES
100 63 1064	FARM-WASTES	TOXICITY TO HOUSE FLIES AND HORN FLIES OF MANURE FROM INSECTICIDE FED CATTLE KEYWORDS
100 65 0699	FARM-WASTES	THE MICROBIOLOGY OF BUILT UP POULTRY LITTER KEYWORDS MICROBIOLOGY BACTERIA FARM-WASTES
100 65 1079	FARM-WASTES	UTILIZATION OF DIFFERENT LEVELS OF POULTRY LITTER NITROGEN BY SHEEP KEYWORDS
100 65 1091	FARM-WASTES	TOXICITY OF DROPPINGS FROM COUMAPHOS-FED HENS TO LITTLE HOUSE FLY LARVAE KEYWORDS
100 66 1080	FARM-WASTES	NITROGEN COMPOUNDS IN NATURAL WATER--A REVIEW KEYWORDS NITROGEN WATER FARM-WASTES GROUN
100 69 1042	FARM-WASTES	THE PROBLEM OF AGRICULTURAL POLLUTION IN WATER TREATMENT KEYWORDS SOURCES ANIMAL-WASTES
100 69 1231	FARM-WASTES	POLLUTION AND EUTROPHICATION PROBLEMS OF GREAT SOUTH BAY LONG ISLAND, NEW YORK KEYWORDS
100 70 1037	FARM-WASTES	NITROGEN IN AGRICULTURE THE PROBLEMS AND THE EFFECT ON THE ENVIRONMENT KEYWORDS
100 70 1040	FARM-WASTES	STABILIZATION OF DAIRY WASTES BY ALGAL-BACTERIAL SYMBIOSIS IN OXIDATION PONDS KEYWORDS
100 70 1041	FARM-WASTES	STATISTICAL EVALUATION OF SALINITY AND NITRATE CONTENT AND TRENDS BENEATH URBAN AND AG
100 70 1090	FARM-WASTES	COUMAPHOS AS A FEED ADDITIVE FOR THE CONTROL OF HOUSE FLY LARVAE IN COW MANURE KEYWORDS
100 70 1251	FARM-WASTES	AIRBORNE AMMONIA EUTROPHIES LAKES KEYWORDS AMMONIA EUTROPHICATION NITROGEN ALGAE WATER-
100 71 0266	FARM-WASTES	CAGED LAYER PERFORMANCE IN PENS WITH OXIDATION DITCHES AND LIQUID MANURE STORAGE TANKS
100 71 0447	FARM-WASTES	LIVESTOCK WASTES - ANNUAL LITERATURE REVIEW KEYWORDS LITERATURE LIVESTOCK FARM-WASTES
100 71 0484	FARM-WASTES	RELATIONSHIPS OF SALMONELLA TO FECAL COLIFORMS IN BOTTOM SEDIMENTS KEYWORD INDICATORS
100 71 1038	FARM-WASTES	CONCENTRATIONS OF POLLUTANTS IN AGRICULTURAL RUNOFF KEYWORDS LAKES WATER-QUALITY TEXAS
100 71 1039	FARM-WASTES	NUTRIENTS IN STREAMS DRAINING WOODLAND AND FARMLAND NEAR COSHOCTON OHIO KEYWORDS
100 71 1047	FARM-WASTES	OXIDATION DITCH IN A CONFINEMENT BEEF BUILDING KEYWORDS FARM-WASTES CONFINEMENT-PENS OX
100 71 1092	FARM-WASTES	EFFECT OF BACILLUS THURINGIENSIS IN CATTLE MANURE ON HOUSE FLY LARVAE KEYWORDS
100 71 1197	FARM-WASTES	NUTRIENT LOSSES FROM AGRICULTURAL LAND KEYWORDS EUTROPHICATION AGRICULTURAL-RUNOFF FERT
100 71 1214	FARM-WASTES	THE DISPOSAL OF AGRICULTURAL WASTE KEYWORDS WASTE-DISPOSAL FARM-WASTES WATER-POLLUTION
100 71 1228	FARM-WASTES	ALTERNATIVES FOR THE TREATMENT AND DISPOSAL OF ANIMAL WASTES KEYWORDS FARM-WASTES DISP
100 71 1236	FARM-WASTES	MIGRATION OF POLLUTANTS IN A GLACIAL OUTWASH ENVIRONMENT KEYWORDS PATH-OF-POLLUTANTS GL
100 72 1129	FARM-WASTES	BEEF CATTLE FEEDLOT RUNOFF, SOLIDS TRANSPORT AND SETTLING CHARACTERISTICS KEYWORDS
100 72 1193	FARM-WASTES	CHARACTERISTICS OF MILKING CENTER WASTE EFFLUENT FROM NEW YORK STATE DAIRY FARMS KEYWOR
100 72 1224	FARM-WASTES	FACTORS AFFECTING THE CONCENTRATION OF FAECAL BACTERIA BACTERIA IN LAND DRAINAGE WATER
100 72 1235	FARM-WASTES	BOD DETERMINATIONS ON FEEDLOT RUNOFF KEYWORDS ANALYTICAL-TECHNIQUES BIOCHEMICAL-OXYGEN-
100 73 1034	FARM-WASTES	TECHNIQUES FOR SAMPLING AND HANDLING OF ANAEROBIC MICROBES IN WASTE FERMENTATION SYSTE
100 73 1069	FARM-WASTES	MANURING OF POTATOES ON PEN SILT SOILS IN HOLLAND LINCOLNSHIRE KEYWORDS
100 73 1086	FARM-WASTES	THE EFFECT OF FEEDING LAYING HENS VARIOUS LEVELS OF COW MANURE ON THE PIGMENTATION OF E
100 73 1087	FARM-WASTES	ENRICHMENT OF THE ATMOSPHERE WITH NITROGEN COMPOUNDS VOLATILIZED FROM A LARGE DAIRY ARE
100 73 1128	FARM-WASTES	USE OF DUCKWEED FOR WASTE TREATMENT AND ANIMAL FEED KEYWORDS FARM-WASTES WASTE-WATER-TR
100 73 1164	FARM-WASTES	SALMONELLA IN THE LAYING HEN I SALMONELLA RECOVERY FROM VISCERA FECES AND EGGS FOLLOWIN
100 73 1165	FARM-WASTES	FLY CONTROL AND CHRONIC TOXICITY FROM FEEDING DURSBAN O-O DIETHYL O-3 5 6-TRICHLORO-2-P
100 73 1184	FARM-WASTES	ANIMAL WASTE MANAGEMENT IN HAWAII KEYWORDS FARM-WASTES LIVESTOCK WASTE-DISPOSAL WASTE-T
100 73 1263	FARM-WASTES	CHROMIC OXIDE AND CRUDE PROTEIN EXCRETION IN THE BOVINE AS INFLUENCED BY WATER RESTRIC
200 66 1112	FARM-WASTES	CATTLE FEEDLOT RUNOFF NATURE AND BEHAVIOR KEYWORDS WATER-POLLUTION-SOURCES SURFACE-RUNO
200 67 0734	FARM-WASTES	CATTLE FEEDLOT WASTE PROBLEMS KEYWORDS FARM-WASTES FEEDLOTS RUNOFF SPRINKLER-IRRIGATION
200 68 0694	FARM-WASTES	THE MANAGEMENT PRINCIPLES APPLICATION TO THE DISPOSAL OF CATTLE MANURE TO PREVENT POLLU
200 68 0726	FARM-WASTES	ECONOMICS OF WATER POLLUTION CONTROL FOR CATTLE FEEDLOT OPERATIONS KEYWORDS FARM-WASTES
200 68 1186	FARM-WASTES	TECHNICAL AND LEGAL CONTROLS FOR THE DISPOSAL OF ANIMAL WASTES KEYWORDS
200 68 1187	FARM-WASTES	THE MANAGEMENT AND DISPOSAL OF DAIRY MANURE KEYWORDS FARM-WASTES MANAGEMENT FARM-MANAGE
200 69 0516	FARM-WASTES	PROCEEDINGS OF FARM ANIMAL WASTE AND BY-PRODUCT MANAGEMENT CONFERENCE KEYWORDS FARM-
200 69 1116	FARM-WASTES	MANAGING LIVESTOCK WASTES TO CONTROL POLLUTION KEYWORDS POLLUTION-CONTROL ORGANIC-LOADI
200 69 1117	FARM-WASTES	WATER POLLUTION BY NUTRIENTS--SOURCES EFFECTS AND CONTROL PAPERS PRESENTED AT 1968 ANNU
200 69 1185	FARM-WASTES	ECONOMICS OF WATER POLLUTION CONTROL KEYWORDS POLLUTION WATER-POLLUTION ECONOMICS HERBI
200 70 0670	FARM-WASTES	ALTERNATIVES FOR THE TREATMENT AND DISPOSAL OF ANIMAL WASTES KEYWORDS FARM-WASTES CON
200 70 1053	FARM-WASTES	BACTERIOLOGICAL WATER QUALITY ANALYSES OF METHODS FOR DETECTING FECAL POLLUTION KEYWORD
200 70 1113	FARM-WASTES	AERATED LAGOON TREATMENT OF LONG ISLAND DUCK WASTES KEYWORDS OXIDATION-LAGOONS FARM-WAS
200 70 1114	FARM-WASTES	ANIMAL MANURE LAGOONS A QUESTIONABLE TREATMENT SYSTEM KEYWORDS FARM-WASTES OXIDATION-LA
200 70 1115	FARM-WASTES	CONTROL OF NITROGEN FROM ANIMAL WASTE WATERS KEYWORDS FARM-WASTES NITROGEN-COMPOUNDS WA
200 70 1118	FARM-WASTES	WATER QUALITY MANAGEMENT PROBLEMS IN ARID REGIONS KEYWORDS CONFERENCES WATER-QUALITY SO
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300 70 1036	FERTILIZERS	AGRICULTURE THE UNSEEN FOE IN THE WAR ON POLLUTION KEYWORDS AGRICULTURE WATER-POLLUTIO
300 70 1059	FERTILIZERS	NITRATE ACCUMULATION IN KANSAS GROUNDWATER KEYWORDS NITRATES GROUNDWATER FERTILIZATION
300 70 1192	FERTILIZERS	IMPLICATIONS OF WATER QUALITY LAWS FOR THE FEEDLOT INDUSTRY KEYWORDS CONTROL POLLUTION-
300 71 0591	FERTILIZERS	AGRICULTURAL POLLUTION OF THE GREAT LAKES BASIN KEYWORDS RUNOFF PESTICIDES EUTROPHICAT
300 71 1059	FERTILIZERS	DEVELOPMENT OF A MATHEMETICAL MODEL TO PREDICT THE ROLE OF SURFACE RUNOFF AND GROUNDWA
300 72 1157	FERTILIZERS	CANADA ANIMAL WASTE MANAGEMENT GUIDE KEYWORDS FARM-WASTES LIVESTOCK PRODUCTION DESIGN M
300 72 1260	FERTILIZERS	NONPOINT RURAL SOURCES OF WATER POLLUTION KEYWORDS WATER POLLUTION RURAL AREAS FERTILIZ
400 65 1127	FERTILIZERS	WHY NITRATES IN WATER SUPPLIES KEYWORDS NITRATES FEED-LOTS FERTILIZERS FARM-WASTES MISS
400 66 0088	FERTILIZERS	POULTRY-MANURE DISPOSAL - IS THERE A PROBLEM KEYWORDS COSTS NUTRIENTS VALUE FERTILIZER
400 68 0229	FERTILIZERS	THE FARM ROLE IN WATER-QUALITY MANAGEMENT KEYWORDS SEDIMENT FERTILIZERS WATER-POLLUTIO
400 69 0016	FERTILIZERS	FERTILIZERS AND FEEDLOTS - WHAT ROLE IN GROUNDWATER POLLUTION KEYWORDS FERTILIZERS SO
400 69 1045	FERTILIZERS	AGRICULTURES CONTRIBUTION TO THE FERTILIZATION OF CANAL LAKE KEYWORDS EUTROPHICATION NU
400 69 1225	FERTILIZERS	CONSERVING RESOURCES AND MAINTAINING A QUALITY ENVIRONMENT KEYWORDS WATER-RESOURCE-DEV
400 70 0070	FERTILIZERS	SOIL AS AN ANIMAL-WASTE DISPOSAL-MEDIUM KEYWORDS N P K SOIL-PROPERTIES SOIL-SURVEYS F
400 70 1176	FERTILIZERS	ANIMAL WASTE DISPOSAL KEYWORDS ANIMAL-WASTES WASTE-DISPOSAL WATER-POLLUTION NITRATES
400 71 0504	FERTILIZERS	COST OF DEHYDRATING POULTRY MANURE KEYWORDS SHELF-LIFE FERTILIZERS EQUIPMENT COST DEH
400 71 1174	FERTILIZERS	LIQUID WASTE SEEPS FROM ONE BASIN TO ANOTHER KEYWORDS AQUIFER CATTLE FARM-WASTES FEED-L
400 71 1196	FERTILIZERS	CATTLE FEEDERS MUST COMPLY WITH ANTI POLLUTION LAWS KEYWORDS LEGAL-ASPECTS POLLUTION-AB
400 72 1130	FERTILIZERS	THE OPCCO DRYER KEYWORDS RECYCLING DRYING FERTILIZERS FARM-WASTES WASTE-TREATMENT
400 72 1166	FERTILIZERS	HOW MUCH MANURE PER ACRE KEYWORDS ANIMAL-WASTES WASTE-DISPOSAL HOGS CATTLE
400 73 1063	FERTILIZERS	AGRICULTURE AND ENVIRONMENT KEYWORDS PHOTOSYNTHESIS WATER-POLLUTION NITRATES PHOSPHATES
400 73 1140	FERTILIZERS	ANOTHER POSSIBLE PROCESS FOR MANURE KEYWORDS FEED-LOTS FARM-WASTES WASTE-TREATMENT FERT
400 73 1168	FERTILIZERS	CALIFORNIA WASTE PONDS ARE PASSING THE TEST KEYWORDS IRRIGATION-STORAGE-PONDS LEACHING
400 73 1183	FERTILIZERS	CONFINEMENT IN ARIZONA KEYWORDS FARM-MANAGEMENT FARM-WASTES CONFINEMENT-PENS FEED-LOTS
500 70 0406	FERTILIZERS	LEGAL-ASPECTS KEYWORDS WATER-POLLUTION PESTICIDES SILTING FERTILIZERS POINT-SOURCES N
500 71 1072	FERTILIZERS	HUMAN AND ANIMAL WASTES AS FERTILIZERS KEYWORDS FARM-WASTES SEWAGE WASTE-DISPOSAL IRRIG
600 71 0497	FERTILIZERS	DEHYDRATION OF ANIMAL WASTES KEYWORDS FARM-WASTES DEHYDRATION FERTILIZERS
600 72 1031	FERTILIZERS	ELECTRIC IN-HOUSE DRYING OF POULTRY WASTE KEYWORDS POULTRY ODOR NUTRIENTS RECYCLING FAR
600 72 1169	FERTILIZERS	CROP YIELDS FROM LAND RECEIVING LARGE MANURE APPLICATIONS KEYWORDS APPLICATION-METHODS
600 73 1147	FERTILIZERS	SOLID WASTE MANAGEMENT FOR CATTLE FEEDLOTS KEYWORDS SOLID-WASTES STORAGE ULTIMATE-DISPO
700 69 1067	FERTILIZERS	ANALYSIS OF ANIMAL WASTE STORAGE AND LAND DISPOSAL SYSTEMS KEYWORDS FARM-WASTES ODOR W
700 71 1120	FERTILIZERS	SOURCES OF PHOSPHATE AMMONIUM AND NITRATE CONTAMINATION IN SOME CENTRAL NEW JERSEY STR
300 69 1044	FERTILIZER-NITROGE	IN SOIL PROFILES AND ON TRANSFORMATIONS OF SOIL NITROGEN KEYWORDS NITRIFICATION SOIL-NI
300 69 1124	FERTILIZER-NITROGE	EFFECT OF VARIOUS FACTORS ON MOVEMENT OF NITRATE NITROGEN IN SOIL PROFILES AND ON TRANS
200 71 0648	FERTILIZER-REQUIRE	FERTILIZER PRACTICES WHICH MINIMIZE NUTRIENT LOSS KEYWORDS FERTILIZER-REQUIREMENTS CR
300 69 0005	FERTILIZER-VALUE	SWINE WASTE MANAGEMENT-PROPERTIES OF SWINE WASTES-FACT SHEET KEYWORDS PHYSICAL-CHEMIC
300 71 1107	FERTILIZSRS	WATER POLLUTION CONTROL LEGISLATION AGRICULTURAL RUNOFF PART 6 KEYWORDS AGRICULTURAL-C
200 71 0279	FERTLIILZERS	POLLUTION - HOW MUCH OF A PROBLEM COMES FROM FERTILIZERS KEYWORDS NITRATE EUTROPHICATI
200 70 0719	FESCUE	FEEDING PROBLEMS ARISING FROM THE USE OF POULTRY LITTER ON PASTURES KEYWORDS FESCUE P
200 70 0720	FESCUE	PROGRESS REPORT PASTURE FERTILIZATION USING POULTRY LITTER KEYWORDS FARM-WASTE WASTE-
200 71 0853	FESCUE-PASTURES	RECYCLING BROILER HOUSE LITTER ON TALL FESCUE PASTURES AT DISPOSAL RATES AND EVIDENCE O
300 67 1250	FIELDS	DISTRIBUTION OF NITRATES AND OTHER WATER POLLUTANTS UNDER FIELDS AND CORRALS IN THE MID
100 67 0041	FIELD-CAPACITY	THE EFFECTS OF FARMYARD MANURE ON MATRIC SUCTIONS PREVAILING IN A SANDY LOAM SOIL KEYW
300 69 1180	FIELD-CROPS	CATTLE FEEDLOT POLLUTION STUDY KEYWORDS CATTLE FEED-LOTS FARM-WASTES WASTE-DISPOSAL RUN
200 72 1022	FIELD-DISPOSAL	RESEARCH NEEDS FOR THE DESIGN AND MANAGEMENT OF BEEF FEEDLOT RUNOFF-CONTROL SYSTEMS KEY
100 70 0021	FIELD-MOISTURE-CAP	EFFECT OF MANURE APPLICATION, AERATION, AND SOIL PH ON SOIL NITROGEN TRANSFORMATIONS AN
100 65 0067	FIELD-SPREADING	EFFLUENT DISPOSAL - STILL A MAJOR PROBLEM KEYWORDS SLURRIES SPRINKLER-IRRIGATION PUMPI
200 71 0604	FIELD-SPREADING	STATUS OF DAIRY CATTLE WASTE TREATMENT AND MANAGEMENT RESEARCH KEYWORDS DAIRY-INDUSTR
200 71 0606	FIELD-SPREADING	POULTRY WASTE MANAGEMENT KEYWORDS EUTROPHICATION ODORS DRYING FIELD-SPREADING POULTRY
200 71 0607	FIELD-SPREADING	SWINE WASTE MANAGEMENT KEYWORDS RUNOFF IRRIGATION-PRACTICES FIELD-SPREADING CONFINEME
300 70 1101	FIELD-STUDIES	BACTERICIDAL EFFECTS OF ALGAE ON ENTERIC ORGANISMS KEYWORDS ALGAE CULTURES ENTERIC-BACT
100 68 1229	FIELD-STUDY	ANAEROBIC LAGOON TREATMENT OF MILKING PARLOR WASTES KEYWORDS ANAEROBIC-CONDITIONS INDUS
200 71 0793	FILTERING-SYSTEM	CONTROL OF ODORS FROM POULTRY HOUSES KEYWORDS ODORS DUST POULTRY FILTERING-SYSTEM AM
300 68 1123	FILTERING-SYSTEMS	A FEASIBILITY STUDY OF A LIVESTOCK WASTE DISPOSAL SYSTEM INVOLVING THE REUSE OF WATER K
100 69 0363	FILTERS	ODOR-TRANSPORT BY PARTICULATE-MATTER IN HIGH DENSITY POULTRY-HOUSES KEYWORDS GAS-CHROM
200 66 0149	FILTERS	EVALUATING ADAPTABILITY OF PASTURE GRASSES TO HYDROPONIC CULTURE AND THEIR ABILITY TO A
200 69 0192	FILTERS	POULTRY HOUSE DUST, ODOR AND THEIR MECHANICAL REMOVAL KEYWORDS FILTERS FOAM-PAD-FILTE
200 72 1025	FILTERS	OTHER RESEARCH NEEDS KEYWORDS FARM-WASTES PROTEINS RUNOFF FEED-LOTS WASTE-DISPOSAL
300 70 0489	FILTERS	WATER-QUALITY REQUIREMENTS AND RE-USE OF WASTEWATER EFFLUENTS KEYWORDS NUTRIENT-REMOV
400 68 0032	FILTERS	NATURAL FILTERS FOR AGRICULTURAL WASTES KEYWORDS SPRINKLER-IRRIGATION EFFLUENTS ORGAN
400 71 0309	FILTERS	CONTROL OF POULTRY HOUSE EXHAUST ODORS KEYWORDS FILTERS DUST WATER-SPRAY CONTROL POUL
200 71 1099	FILTERS-EQUIPMENT	SUMMER CONFERENCE OF SOCIETY FOR APPLIED BACTERIOLOGY KEYWORDS MICROORGANISMS WATER-POL
200 66 0119	FILTH-FLIES	BIOLOGICAL INTERRELATIONSHIPS BETWEEN FECES AND FLIES KEYWORDS FILTH-FLIES CONFINEMENT
100 71 1212	FILTRATION	EFFECTS OF MULTIPLE USE ON WATER QUALITY OF HIGH MOUNTAIN WATERSHEDS BACTERIOLOGICAL IN
100 72 1222	FILTRATION	PEPSIN DIGESTIBILITY METHOD FOR ANIMAL PROTEINS KEYWORDS DIGESTION FILTRATION ANALYTICA
100 72 1224	FILTRATION	FACTORS AFFECTING THE CONCENTRATION OF FAECAL BACTERIA BACTERIA IN LAND DRAINAGE WATER
200 68 1242	FILTRATION	THE MOVEMENT OF DISEASE PRODUCING ORGANISMS THROUGH SOILS KEYWORDS WATER-REUSE PATHOGEN
200 72 1030	FILTRATION	RECOVERY OF ANIMAL FEED FROM CATTLE MANURE KEYWORDS RECYCLING FARM-WASTES CATTLE FEED-L
300 68 1123	FILTRATION	A FEASIBILITY STUDY OF A LIVESTOCK WASTE DISPOSAL SYSTEM INVOLVING THE REUSE OF WATER K
100 70 1194	FINANCING	REVIEW OF NATIONAL RESEARCH POLICY ON EUTROPHICATION PROBLEMS KEYWORDS EUTROPHICATION
200 71 0612	FINANCING	PROVIDING TECHNICAL AND FINANCIAL ASSISTANCE TO FARMERS FOR ANIMAL WASTE DISPOSAL SYSTE
300 71 1246	FINANCING	FEEDLOT WASTE MANAGEMENT KEYWORDS WATER-POLLUTION-CONTROL CONFINEMENT-PENS CATTLE POLLU
300 70 1000	FINISHING-BUILDING	EQUIPMENT AND FACILITIES FOR MODERN METHODS OF SWINE MANURE DISPOSAL KEYWORDS
100 62 1220	FISH	WATER POLLUTION RESULTING FROM AGRICULTURAL ACTIVITIES KEYWORDS WATER-POLLUTION-SOURCES
100 70 0051	FISH	IMPACT OF AGRICULTURAL POLLUTANTS ON WATER USES KEYWORDS BOD COD DISPOSAL IRRIGATION L
100 71 0742	FISH	INFECTIONS PANCREATIC NECROSIS VIRUS COMPARATIVE FREQUENCIES OF ISOLATION FROM FECES A
100 71 1221	FISH	DETERMINATION OF MERCURY IN FOOD PRODUCTS AND BIOLOGICAL FLUIDS BY AERATION & FLAMELESS
200 64 0759	FISH	STREAM POLLUTION FROM FEEDLOT RUNOFF KEYWORD KANSAS BIOCHEMICAL-OXYGEN-DEMAND CHEMICA
300 49 1210	FISH	MEASURE AND ELEMENTS OF DAMAGES FOR POLLUTION OF A STREAM KEYWORDS JUDICIAL-DECISIONS D
300 70 1104	FISH	FISH AS POTENTIAL VECTORS OF HUMAN BACTERIAL DISEASES KEYWORDS DISEASES VECTROS-BIOLOGY
300 71 1098	FISH	BIBLIOGRAPHY OF PRODUCTS DERIVED FROM AQUATIC ORGANISMS KEYWORDS AQUATIC-PLANTS FISH PO
300 71 1100	FISH	DETERMINATION ON MERCURY IN SAMPLES FROM THE DUTCH ENVIRONMENT KEYWORDS MERCURY NEUTRO
500 70 0406	FISH	EFFECTS OF AGRICULTURAL-POLLUTANTS ON RECREATIONAL-USES OF SURFACE-WATERS KEYWORDS R
100 69 1231	FISHERIES	POLLUTION AND EUTROPHICATION PROBLEMS OF GREAT SOUTH BAY LONG ISLAND, NEW YORK KEYWORDS
100 70 1194	FISHERIES	REVIEW OF NATIONAL RESEARCH POLICY ON EUTROPHICATION PROBLEMS KEYWORDS EUTROPHICATION
300 71 1245	FISHFILL	EFFECTS OF FEEDLOT RUNOFF ON WATER QUALITY OF IMPOUNDMENTS KEYWORDS RESERVOIR FISHFILL
100 68 1121	FISHKILL	WATER POLLUTION FROM LAND RUNOFF KEYWORDS RUNOFF WATER-POLLUTION INFILTRATION SEDIMENTS

200	67	1243	FISHKILL	THE IMPACT OF ANIMAL WASTES ON WATER RESOURCES ACTIVITIES KEYWORDS ANIMAL-WASTES WASTES
200	69	0482	FISHKILL	THE EFFECTS OF FARM WASTES ON THE POLLUTION OF NATURAL WATERS KEYWORC GROUNDWATER NUT
200	71	0641	FISHKILL	BACTERIAL COUNTS OF A SECTION OF THE RED RIVER-SUMMER 1970 KEYWORDS COLIFORMS BACTERI
300	64	1110	FISHKILL	LAKE TERMINOLOGY WATER BLOOM KEYWORDS EUTROPHICATION ALGAE DUCKS COLOR FISHKILL LAKES
300	67	0701	FISHKILL	WATER POLLUTION AND AGRICULTURE KEYWORDS RUNOFF RAINFALL BACTERIA BOD COLIFORM FISHK
300	71	1057	FISHKILL	EFFECTS OF POLLUTION ESPECIALLY FROM FEEDLOTS ON FISHES IN THE UPPER NEOSHO RIVER BASI
100	71	0742	FISH-DISEASES	INFECTIONS PANCREATIC NECROSIS VIRUS COMPARATIVE FREQUENCIES OF ISOLATION FROM FECES A
100	70	1051	FISH-HATCHERIES	POLLUTION POTENTIAL OF SALMONID FISH HATCHERIES KEYWORDS FISH-HATCHERIES SALMONIDS SOUR
100	71	0742	FISH-HATCHERIES	INFECTIONS PANCREATIC NECROSIS VIRUS COMPARATIVE FREQUENCIES OF ISOLATION FROM FECES A
100	70	1237	FISH-HATCHERIES	POLLUTION POTENTIAL OF SALMONID FISH HATCHERIES KEYWORDS SOURCES FISH-HATCHERIES SALMON
200	69	0541	FISH-KILL	FEEDLOT POLLUTION SLIDE SHOW KEYWORDS RUNOFF FISH-KILL IRRIGATION FARM LAGOONS ODOR C
200	69	0542	FISH-KILL	ANIMAL WASTE POLLUTION-OVERVIEW OF THE PROBLEM KEYWORDS RUNOFF GROUNDWATER FISH-KILL
200	69	0543	FISH-KILL	INDUSTRY S ROLE IN FEEDLOT POLLUTION CONTROL KEYWORDS CATTLE FISH-KILL KANSAS ECONOMI
100	70	1194	FISH-KILLS	REVIEW OF NATIONAL RESEARCH POLICY ON EUTROPHICATION PROBLEMS KEYWORDS EUTROPHICATION
100	71	0742	FISH-MANAGEMENT	INFECTIONS PANCREATIC NECROSIS VIRUS COMPARATIVE FREQUENCIES OF ISOLATION FROM FECES A
200	69	1117	FISH-POPULATION	WATER POLLUTION BY NUTRIENTS--SOURCES EFFECTS AND CONTROL PAPERS PRESENTED AT 1966 ANNU
300	71	1098	FISH-PROTEIN	BIBLIOGRAPHY OF PRODUCTS DERIVED FROM AQUATIC ORGANISMS KEYWORDS AQUATIC-PLANTS FISH PO
100	66	1080	FIXATION	NITROGEN COMPOUNDS IN NATURAL WATER--A REVIEW KEYWORDS NITROGEN WATER FARM-WASTES GROUN
500	70	0393	FIXATION	CHEMISTRY OF NITROGEN IN SOILS KEYWORDS NITRATES AMMONIUM FIXATION NITRITES LEACHING
600	72	1076	FLASH-VOLITALIZATI	HIGH-TEMPERATURE HIGH-PRESSURE EXTRUSION OF CHICKEN EXCRETA KEYWORDS FARM-WASTES POULTR
100	65	1091	FLIES	TOXICITY OF DROPPINGS FROM COUMAPHOS-FED HENS TO LITTLE HOUSE FLY LARVAE KEYWORDS
200	66	0119	FLIES	BIOLOGICAL INTERRELATIONSHIPS BETWEEN FECES AND FLIES KEYWORDS FILTH-FLIES CONFINEMENT
200	66	0130	FLIES	DISPOSAL OF POULTRY MANURE BY PLOW-FURROW-COVER KEYWORDS ODOR SLURRIES FURROWS FLIES L
400	69	0039	FLOATING-AERATOR	LABOR FREE MANURE DISPOSAL KEYWORDS FLOATING-AERATOR ODOR LAGOON AEROBIC-BACTERIA SPRI
200	70	1113	FLOCCULATION	AERATED LAGOON TREATMENT OF LONG ISLAND DUCK WASTES KEYWORDS OXIDATION-LAGOONS FARM-WAS
300	68	1123	FLOCCULATION	A FEASIBILITY STUDY OF A LIVESTOCK WASTE DISPOSAL SYSTEM INVOLVING THE REUSE OF WATER K
300	72	1170	FLOOD-IRRIGATION	POLLUTION LOADS IN PERCOLATE WATER FROM SURFACE SPREAD SWINE WASTES KEYWORDS
400	73	1158	FLOOD-PROTECTION	DO YOU HAVE TO MOVE EM OR CAN YOU LEAVE EM KEYWORDS FEED-LOTS RUNOFF WASTE-STORAGE WAST
100	70	0691	FLOORING	THE EFFECT OF HUMIDITY AND FLOORING TYPE ON THE MOISTURE CONTENT OF BROILER EXCREMENTS
100	71	0567	FLORA	BACTERIAL AND FUNGAL FLORA OF SEAGULL DROPPINGS IN JERSEY KEYWORDS BACTERIAL FLORA SEA
200	70	0755	FLORICA	FEEDLOT WASTE IN FLORIDA KEYWORD WASTE-TREATMENT BIOLOGICAL-TREATMENT WASTE-DISPOSAL
300	69	0093	FLOW	HYDROLOGIC ASPECTS OF FEEDLOT WASTE CONTROL KEYWORDS BOD DC RIVERS WATER-QUALITY STREAM
200	66	0121	FLOWABILITY	PHYSICAL PROPERTIES OF ANIMAL MANURES ASSOCIATED WITH HANDLING KEYWORDS PHYSICAL-PROP
200	71	0703	FLOWMETERS	FEEDLOT WASTE MANAGEMENT SOME SOLUTIONS TO THE PROBLEM KEYWORDS MOISTURE-CONTENT SAM
300	70	0488	FLOW-AUGMENTATION	THE EFFECTS OF SALINITY-STANDARDS ON IRRIGATED-AGRICULTURE IN THE COLORADO-RIVER-BASIN
300	71	0732	FLOW-CHARACTERISTI	CLOSED SYSTEMS FOR ANIMAL SEWAGE TREATMENT KEYWORD ENVIRONMENTAL-EFFECTS DAIRY-INDUST
600	70	0080	FLOW-CHARACTERISTI	FLOW PROPERTIES OF ANIMAL WASTE SLURRIES KEYWORDS VISCOSITY FLOW-CHARACTERISTICS SHEA
300	71	0745	FLOW-CONTROL	ANIMAL WASTES KEYWORDS INDUSTRIAL-WASTES FLOW-CONTROL TERRACES BY-PRODUCTS RENDERING
100	69	0052	FLOW-NET	NITROGEN CONTAMINATION OF GROUNDWATER BY BARNYARD LEACHATES KEYWORDS PIEZOMETERS FLOW-N
100	72	1224	FLOW-RATES	FACTORS AFFECTING THE CONCENTRATION OF FAECAL BACTERIA BACTERIA IN LAND DRAINAGE WATER
600	72	1001	FLOW-RATES	INCLINED-PLANE TRICKLING FILTER FOR SWINE WASTE KEYWORDS WASTE-TREATMENT AEROBIC-TREATM
200	72	1015	FLUMES	DESIGN AND MANAGEMENT OF RUNOFF CONTROL SYSTEMS KEYWORDS FARM-WASTES FEED-LOTS CATTLE R
100	68	0296	FLUSHING	A NEW APPROACH TO CAGE WASTE DISPOSAL IN A CANINE LABORATORY KEYWORDS DOG FLUSHING
300	69	1180	FLUSHING	CATTLE FEEDLOT POLLUTION STUDY KEYWORDS CATTLE FEED-LOTS FARM-WASTES WASTE-DISPOSAL RUN
100	69	0058	FLUSHING-GUTTERS	REUSE OF WASH WATER FOR CLEANING CAGED LAYER HOUSES KEYWORDS RECIRCULATED-WATER STORA
100	70	0089	FLUSHING-GUTTER	TREATMENT, USE, AND DISPOSAL OF WASTES FROM MODERN AGRICULTURE KEYWORDS AERATION ODOR
200	70	0234	FLUSHING-GUTTER	FARM WASTES KEYWORDS DISPOSAL UNITED-KINGDOM SLURRIES BOD COD DO ODOR COSTS EQUIPMENT
200	70	0248	FLUSHING-GUTTER	PIGGERY CLEANING USING RENOVATED WASTES KEYWORDS DISPOSAL EQUIPMENT OXIDATION-DITCH F
300	68	0352	FLUSHING-GUTTERS	DISPOSAL OF WASTES FROM SWINE FEEDING FLOORS TO MINIMIZE STREAM POLLUTION KEYWORDS SE
400	70	0097	FLUSHING-GUTTER	POULTRY MANURE LAGOON DESIGN KEYWORDS RECIRCULATED-WATER AERATION EQUIPMENT COSTS FL
400	71	0339	FLUSHING-GUTTER	FLUSHING AWAY MANURE PROBLEMS KEYWORDS RECIRCULATED WATER HOGS OXIDATION-DITCH FLUSHI
600	71	0272	FLUSHING-GUTTERS	A DOSING-SIPHON FOR DISCHARGING CLEANING-WATER INTO FLUSHING-GUTTERS KEYWORDS DESIGN
600	72	1071	FLUSHING-GUTTER	A COMPARISON OF THREE SYSTEMS FOR TRANSPORT AND TREATMENT OF SWINE MANURE KEYWORDS
100	70	0570	FLY	MANURE MITES AND THEIR ROLE IN FLY CONTROL KEYWORDS INSECT-CONTROL CATTLE POULTRY OVI
100	71	0348	FLY	BIOLOGICAL FLY CONTROL IN DEEP PITS KEYWORDS POULTRY BIOLOGICAL FLY PITS
400	71	0350	FLY	SCHEDULE MANURE REMOVAL TO AVOID FLY BREEDING KEYWORDS CALIFORNIA POULTRY ODORS FLY
100	64	0371	FLY-BREEDING	THIN-SPREADING OF SLURRIED-MANURES KEYWORDS DRYING LAYERS MOISTURE-CONTENT SOLIDS-PER
100	67	0501	FLY-CONTROL	INVESTIGATIONS ON FLY-CONTROL BY COMPOSTING POULTRY-MANURES KEYWORDS TEMPERATURE DEGRA
100	71	1092	FLY-CONTROL	EFFECT OF BACILLUS THURINGIENSIS IN CATTLE MANURE ON HOUSE FLY LARVAE KEYWORDS
100	73	1165	FLY-CONTROL	FLY CONTROL AND CHRONIC TOXICITY FROM FEEDING DURSBAN O-O DIETHYL O-3 5 6-TRICHLORO-2-P
300	71	0515	FLY-CONTROL	FECAL RESIDUES FROM LARVICIDES--POULTRY AND CATTLE KEYWORDS PATHOGENIC-BACTERIA BORON
400	71	0294	FLY-CONTROL	MANURE MITES IN INTEGRATED FLY CONTROL KEYWORDS POULTRY CALIFORNIA FLY-CONTROL
400	73	1191	FLY-PARASITES	MOVE TO NEW LOCATION SOLVES MANY PROBLEMS FOR CUSTOM FEEDER KEYWORDS
300	71	0477	FLY-PUPAE	BIOLOGICAL CONVERSION OF ANIMAL WASTES TO NUTRIENTS KEYWORDS POULTRY FLY-PUPAE NUTRIENT
100	68	0106	FOAMING	OXIDATION DITCHES FOR WASTE DISPOSAL KEYWORDS HOGS BOD ROTORS FOAMING SLUDGE ODOR OXY
100	70	0089	FOAMING	TREATMENT, USE, AND DISPOSAL OF WASTES FROM MODERN AGRICULTURE KEYWORDS AERATION ODOR
200	69	0193	FOAMING	CHARACTERISTICS OF AQUEOUS SOLUTION OF CATTLE MANURE KEYWORDS BOD PH REDOX-POTENTIAL
300	68	0749	FOAMING	ROTOR AERATION OF SWINE WASTES KEYWORD OXIDATION TREATMENT GASES ODORS CONFINEMENT-PF
300	69	0006	FOAMING	SWINE WASTE MANAGEMENT-OXIDATION DITCH FOR TREATING HOG WASTES-FACT SHEET KEYWORDS DE
300	71	1119	FOAMING	TREATMENT OF AQUEOUS AGRICULTURAL WASTES FOR CLEAN WATER AND FOR MICROBIAL PROTEIN PROD
600	70	0098	FOAMING	BEEF CONFINEMENT SYSTEMS - OXIDATION DITCH KEYWORDS COD BOD TS TVS PH DO TEMPERATURE
200	69	0192	FOAM-PAD-FILTERS	POULTRY HOUSE DUST, ODOR AND THEIR MECHANICAL REMOVAL KEYWORDS FILTERS FOAM-PAD-FILTE
200	70	0222	FOLIAR-APPLICATION	THE NITROGEN-CYCLE OF A DAIRY FARM KEYWORDS NUTRIENTS FERTILIZATION FOLIAR-APPLICATION
200	64	1240	FOODS	THE PHYSIOLOGY OF THE COLIFORM GROUP KEYWORDS BACTERIA COLIFORMS POLLUTANTS SANITARY-E
300	70	1247	FOODS	DISPOSAL OF INDUSTRIAL WASTES KEYWORDS OREGON INDUSTRIAL-WASTES WASTE-DISPOSAL POLLUTIO
300	71	1100	FOODS	DETERMINATION ON MERCURY IN SAMPLES FROM THE DUTCH ENVIRONMENT KEYWORDS MERCURY NEUTRO
500	71	1254	FOODS	ISOLATION OF ANAEROBES KEYWORDS ISOLATION CULTURES SOIL-BACTERIA PROTOZOA FUNGI PHOTOS
100	70	1051	FOOD-ABUNDANCE	POLLUTION POTENTIAL OF SALMONID FISH HATCHERIES KEYWORDS FISH-HATCHERIES SALMONIDS SOUR
400	71	1172	FOOD-AND-DRUG-ADMI	OXIDATION DITCH IS CATTLE FEED SOURCE KEYWORDS OXIDATION-LAGOONS FEEDS EFFLUENT CATTLE
400	73	1068	FOOD-AND-DRUG-ADMI	NEW FEEDLOT CONCEPT USES CONVERTED MANURE AS FEED KEYWORDS RECYCLING FARM-WASTES CATTLE
100	70	1111	FOOD-CHAINS	POLYCHLORINATED BIPHENYLS KEYWORDS CHLORINATED-HYDROCARBON-PESTICIDES FOOD-CHAINS PESTI
300	69	1125	FOOD-PRODUCTION-WA	ANIMAL WASTE DISPOSAL PROBLEMS AND TRENDS IN MINNESOTA KEYWORDS LIVESTOCK WASTES FARM-W
100	69	0045	FORAGE	THE POTENTIAL DIGESTIBILITY OF CELLULOSE IN FORAGE AND FAECES KEYWORDS INCUBATION GRA
600	72	1169	FORAGE	CROP YIELDS FROM LAND RECEIVING LARGE MANURE APPLICATIONS KEYWORDS APPLICATION-METHODS
600	72	1177	FORAGE-YIELDS	DISPOSAL OF BEEF FEEDLOT WASTES ONTO CROPLAND KEYWORDS FARM-WASTES WASTE-DISPOSAL CATTL
200	73	1062	FORCED-AIR-OVENS	CONTINUED RECYCLING OF CATTLE MANURE KEYWORDS CATTLE FARM-WASTES RECYCLING NITROGEN CAL
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100 70 1233  LEACHING           LOSSES OF NITROGEN AND PHOSPHORUS FROM AGRICULTURAL LAND KEYWORDS WATER-POLLUTION-SOURC
100 71 1039  LEACHING           NUTRIENTS IN STREAMS DRAINING WOODLAND AND FARMLAND NEAR COSHOCTON OHIO KEYWORDS
100 71 1197  LEACHING           NUTRIENT LOSSES FROM AGRICULTURAL LAND KEYWORDS EUTROPHICATION AGRICULTURAL-RUNOFF FERT
200 69 0429  LEACHING           CONTRIBUTION OF FERTILIZERS TO WATER POLLUTION  KEYWORDS  EUTROPHICATION EROSION NITROG
200 71 0826  LEACHING           CROP PRODUCTION AND SOIL ANALYSIS AS AFFECTED BY APPLICATIONS OF CATTLE FEEDLOT WASTE
200 71 0830  LEACHING           FATE OF INORGANIC FORMS OF N AND SALT FROM LAND-DISPOSED MANURES FROM DAIRIES  KEYWORDS
200 71 0854  LEACHING           MOVEMENT OF POLLUTANT PHOSPHORUS IN SATURATED SOILS  KEYWORD  FERTILIZERS NUTRIENT-REMO
200 71 0856  LEACHING           GROWTH RESPONSE OF PLANTS UNDER SPRINKLER IRRIGATION WITH DAIRY WASTES  KEYWORD  FERTIL
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300    1077  LEACHING           SOIL CONDITIONS UNDER FEEDLOTS AND ON LAND TREATED WITH LARGE AMOUNTS OF ANIMAL WASTES
300 70 1036  LEACHING           AGRICULTURE  THE UNSEEN FOE IN THE WAR ON POLLUTION KEYWORDS AGRICULTURE WATER-POLLUTIO
300 71 1107  LEACHING           WATER POLLUTION CONTROL LEGISLATION AGRICULTURAL RUNOFF PART 6  KEYWORDS AGRICULTURAL-C
400 73 1168  LEACHING           CALIFORNIA WASTE PONDS ARE PASSING THE TEST KEYWORDS IRRIGATION-STORAGE-PONDS LEACHING
500 70 0393  LEACHING           CHEMISTRY OF NITROGEN IN SOILS  KEYWORDS NITRATES AMMONIUM  FIXATION NITRITES LEACHING
500 71 1072  LEACHING           HUMAN AND ANIMAL WASTES AS FERTILIZERS KEYWORDS FARM-WASTES SEWAGE WASTE-DISPOSAL IRRIG
600 69 1239  LEACHING           DRAIN INSTALLATION FOR NITRATE REDUCTION KEYWORDS CALIFORNIA DRAINS INSTALLATION NITRAT
700 71 1120  LEACHING           SOURCES OF PHOSPHATE AMMONIUM AND NITRATE CONTAMINATION IN  SOME CENTRAL NEW JERSEY STA
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200 69 0431	LEGAL-ASPECTS	MAJOR PROBLEMS OF WATER POLLUTION CREATED BY AGRICULTURAL PRACTICES KEYWORDS EROSION
200 69 0756	LEGAL-ASPECTS	SWINE-WASTE MANAGEMENT KEYWORDS LEGAL-ASPECTS DESIGN-CRITERIA HOGS ODOR TREATMENT FAC
200 70 0235	LEGAL-ASPECTS	ORIGINS AND NATURE OF FARM WASTES KEYWORDS DISPOSAL COSTS LEGAL-ASPECTS ECONOMICS UK
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100 69 0096  MERCAPTANS           IDENTIFICATION OF GASES IN A CONFINEMENT SWINE BUILDING ATMOSPHERE  KEYWORDS  ODOR ORGA
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100 71 0573  METHOD               METHODS OF REMOVING SETTLEABLE SOLIDS FROM OUTDOOR BEEF CATTLE FEEDLOT RUNOFF  KEYWORDS
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100 69 0360  MICROORGANISMS      THE BACTERIAL-POPULATION OF AN INDOOR POULTRY-LAGOON KEYWORDS  E-COLI BOD MICROORGANISM
100 70 0094  MICROORGANISMS      THE INFLUENCE OF AERATION ON THE COMPOSTING OF POULTRY MANURE-GROUND CORNCOB MIXTURES
100 70 0362  MICROORGANISMS      DISTRIBUTION OF BACTERIA IN FECES OF SWINE  KEYWORDS MICROORGANISMS PATTERNS SWINE
100 71 1213  MICROORGANISMS      A COMPUTER PROGRAM FOR IDENTIFYING MICROORGANISMS KEYWORDS PATHOGENIC-BACTERIA ENTERIC-
200 66 0136  MICROORGANISMS      ON-SITE COMPOSTING OF POULTRY MANURE  KEYWORDS  LITTERLIFE  FECAL-MATERIAL HEAT-OF-COMP
200 69 1102  MICROORGANISMS      MICROBIOLOGY OF A WASTE STABILIZATION POND KEYWORDS BIOLOGICAL-TREATMENT MICROBIOLOGY O
200 71 0785  MICROORGANISMS      A TOTAL BIOCHEMICAL RECYCLE PROCESS FOR CATTLE WASTES  KEYWORDS  LIQUID-WASTES PHOSPHAT
200 71 0795  MICROORGANISMS      ANTIBIOTIC RESISTANCE AND RESISTANCE TRANSFER BETWEEN BACTERIAL ISOLATES IN A WASTE LAG
200 71 0796  MICROORGANISMS      DIFFERENTIATION OF RUMINANT FROM NON-RUMINANT FECAL SOURCES OF WATER POLLUTION BY USE O
200 71 0797  MICROORGANISMS      GROWTH KINETICS OF RUMEN BACTERIA IN SOLUTIONS OF POULTRY EXCRETA  KEYWORDS  FEED MICRO
200 71 0845  MICROORGANISMS      CATTLE MANURE AS FEED FOR CATTLE  KEYWORD  RECYCLING ANIMAL-PATHOLOGY MICROORGANISMS ME
200 71 1099  MICROORGANISMS      SUMMER CONFERENCE OF SOCIETY FOR APPLIED BACTERIOLOGY KEYWORDS MICROORGANISMS WATER-POL
300 68 1043  MICROORGANISMS      WASTES IN RELATION TO AGRICULTURE AND FORESTRY KEYWORDS SOURCES WATER-POLLUTION-EFFECTS
300 71 1126  MICROORGANISMS      SAVANNAH RIVER ECOLOGY LABORATORY ANNUAL REPORT 1971 KEYWORDS BORON NUTRIENT-REQUIREMEN
400 70 0097  MICROORGANISMS      POULTRY MANURE LAGOON DESIGN  KEYWORDS  RECIRCULATED-WATER  AERATION EQUIPMENT COSTS FL
500 70 0393  MICROORGANISMS      CHEMISTRY OF NITROGEN IN SOILS  KEYWORDS NITRATES AMMONIUM  FIXATION NITRITES LEACHING
500 70 0400  MICROORGANISMS      MANURE DECOMPOSITION AND FATE OF BREAKDOWN PRODUCTS IN SOILS  KEYWORDS  DISPOSAL FERTIL
500 70 0401  MICROORGANISMS      MANURE TRANSFORMATIONS AND FATE OF DECOMPOSITION PRODUCTS IN WATER KEYWORDS  DISPOSAL M
200 64 1240  MICRO-ORGANISMS     THE PHYSIOLOGY OF THE COLIFORM GROUP KEYWORDS  BACTERIA COLIFORMS POLLUTANTS SANITARY-E
700 71 1120  MIDDLESEX-COUNTY-N  SOURCES OF PHOSPHATE AMMONIUM AND NITRATE CONTAMINATION IN  SOME CENTRAL NEW JERSEY STR
100 64 1200  MIDGES              PROGRESSIVE CHANGES IN THE CLADOCERAN AND MIDGE FAUNA DURING THE ONTOGENY OF ESTHWAITE
100 59 0459  MIDWEST             LIQUID MANURE FOR MIDWEST SWINE PRODUCTION KEYWORDS  LIQUID MANURE MIDWEST
200 71 0779  MIDWEST             EVALUATION OF BEEF FEEDLOT WASTE MANAGEMENT ALTERNATIVES KEYWORDS FARM-WASTES WASTE-TRE
100 70 1040  MILK                COUMAPHOS AS A FEED ADDITIVE FOR THE CONTROL OF HOUSE FLY LARVAE IN COW MANURE KEYWORDS
100 72 1199  MILK                IMPROVED PROCEDURES FOR THE DETERMINATION OF OXYTETRACYCLINE IN MILK MILK PRODUCTS CHIC
200 64 1240  MILK                THE PHYSIOLOGY OF THE COLIFORM GROUP KEYWORDS  BACTERIA COLIFORMS POLLUTANTS SANITARY-E
300 71 1100  MILK                DETERMINATION ON MERCURY IN SAMPLES FROM THE DUTCH ENVIRONMENT  KEYWORDS MERCURY NEUTRO
100 68 1229  MILKING-PARLOR      ANAEROBIC LAGOON TREATMENT OF MILKING PARLOR WASTES KEYWORDS ANAEROBIC-CONDITIONS INDUS
100 71 1221  MILK-POULTRY        DETERMINATION OF MERCURY IN FOOD PRODUCTS AND BIOLOGICAL FLUIDS BY AERATION & FLAMELESS
100 72 1199  MILK-PRODUCTS       IMPROVED PROCEDURES FOR THE DETERMINATION OF OXYTETRACYCLINE IN MILK MILK PRODUCTS CHIC
100 65 1219  MINERALIZATION      NITRATES IN THE ENVIRCMENT KEYWORDS NITROGEN  ATMOSPHERE BIOSPHERE FERTILIZATION NITROG
200 69 0196  MINERALOGY          THE INFLUENCE OF VARIOUS FACTORS ON POULTRY LITTER COMPOSITION  KEYWORDS  NITROGEN CARB
100 69 0037  MINIMUM-REMOVAL-EF  WATER POLLUTION CONTROL LEGISLATION-CONDENSATION  KEYWORDS  WATER-QUALITY-ACT BOD PHOSP
700 72 1049  MINIMUM-TILLAGE     ECONOMICS OF WATER QUALITY MANAGEMENT  EXEMPLIFIED BY SPECIFIED POLLUTANTS IN AGRICULTU
200 70 1050  MINING              THE LEGAL FUTURE  NEW THEORIES OF ENVIRONMENTAL PROTECTION  KEYWORDS ENVIRONMENTAL-SANI
300 71 1098  MINK                BIBLIOGRAPHY OF PRODUCTS DERIVED FROM AQUATIC ORGANISMS KEYWORDS AQUATIC-PLANTS FISH PO
200 69 0544  MINNESOTA           HOW TO CONDUCT A STATE INVENTORY  KEYWORDS  CATTLE INVESTIGATIONS RUNOFF LEGISLATION MI
200 69 1116  MINNESOTA           MANAGING LIVESTOCK WASTES TO CONTROL POLLUTION KEYWORDS POLLUTION-CONTROL ORGANIC-LOADI
200 71 0599  MINNESOTA           THE MINNESOTA SCENE LIVESTOCK FEEDLOT, WASTE CONTROL, PROGRESS--PROBLEMS  KEYWORDS  REG
200 72 1017  MINNESOTA           WASTE MANAGEMENT AND ANIMAL PERFORMANCE KEYWORDS FEED-LOTS FARM-WASTES WASTE-TREATMENT
300 69 1125  MINNESOTA           ANIMAL WASTE DISPOSAL PROBLEMS AND TRENDS IN MINNESOTA KEYWORDS LIVESTOCK WASTES FARM-W
300 71 1058  MINNESOTA           DEVELOPMENT OF A MATHEMETICAL MODEL TO PREDICT THE ROLE OF  SURFACE RUNOFF AND GROUNDWA
200 69 0158  MISCONCEPTION       REFLECTIONS ON POLLUTION CONTROL  KEYWORDS  WATER-QUALITY COST-BENEFIT-RATIO ENVIRONMEN
600 71 0288  MISSISSIPPI         FIELD CROP IRRIGATION WITH OXIDATION POND EFFLUENT KEYWORDS  MISSISSIPPI IRRIGATION OXI
200 69 0554  MISSOURI            MISSOURI S ANIMAL WASTE MANAGEMENT  KEYWORDS  REGULATION POLLUTION-ABATEMENT ADMINISTRA
200 72 1017  MISSOURI            WASTE MANAGEMENT AND ANIMAL PERFORMANCE KEYWORDS FEED-LOTS FARM-WASTES WASTE-TREATMENT
200 73 1189  MISSOURI            A FEEDER LOOKS AT ANIMAL WASTE DISPOSAL KEYWORDS FARM-WASTES WASTE-DISPOSAL FEED-LOTS F
300 65 0739  MISSOURI            NITRATE AND WATER  KEYWORD  FERTILIZERS LEGUMES MISSOURI ALFALFA LIVESTOCK NITRATE
300 70 0073  MISSOURI            STOCKMEN S LIABILITY UNDER THE MISSOURI NUISANCE LAW KEYWORDS  ODOR NOISE LAWSUITS DAMA
300 70 0383  MISSOURI            PORK PRODUCERS AND POLLUTION  LEGAL ASPECTS  KEYWORDS  LAW  LEGAL-PROCEDURE REGULATION
300 71 0590  MISSOURI            THE MISSOURI APPROACH TO ANIMAL WASTE MANAGEMENT  KEYWORDS  LAGOONS DESIGN IRRIGATION M
300 71 1107  MISSOURI            WATER POLLUTION CONTROL LEGISLATION AGRICULTURAL RUNOFF PART 6  KEYWORDS AGRICULTURAL-C
400 65 1127  MISSOURI            WHY NITRATES IN WATER SUPPLIES KEYWORDS NITRATES FEED-LOTS FERTILIZERS FARM-WASTES MISS
400 65 1141  MISSOURI            NITRATES DANGER FOR HUMANS, TOO KEYWORDS FEED-LOTS WATER-WELLS NITRATES FARM-WASTES MIS
400 72 1179  MISSOURI            THE PRICE TAG TO STOP FEEDLOT RUN OFF KEYWORDS FARM-WASTE WASTE-DISPOSAL FEED-LOTS SETT
300 71 1246  MISSOURI-RIVER      FEEDLOT WASTE MANAGEMENT KEYWORDS WATER-POLLUTION-CONTROL CONFINEMENT-PENS CATTLE POLLU
200 71 0277  MIS-USE             THE FARMERS  CONCERN  KEYWORDS  PESTICIDES WATER-POLLUTION  PANIC-POWER MIS-USE RESISTA
100 70 0421  MITE-PREDATION      EFFECTS OF MANURE APPLICATIONS AND MITE PREDATION ON CORN ROOTWORM POPULATIONS IN MINNE
100 69 0095  MIXED-LIQUOR        BIO-OXIDATION OF SWINE-WASTE BY THE ACTIVATED-SLUDGE PROCESS  KEYWORDS MODEL-STUDIES AN
200 70 0252  MIXING              ANAEROBIC TREATMENT OF FARM WASTES  KEYWORDS  BACTERIA SLUDGE SLURRIES DESIGN-DATA METH
200 70 1113  MIXING              AERATED LAGOON TREATMENT OF LONG ISLAND DUCK WASTES KEYWORDS OXIDATION-LAGOONS FARM-WAS
400 64 0335  MIXING              EQUIPMENT FOR DISPOSAL OF AGRICULTURAL EFFLUENTS  KEYWORDS  SLURRIES STORAGE-TANKS SPRI
400 71 0349  MIXING              MAXI-MIXING FOR MANURE DISPOSAL  KEYWORDS  POULTRY COMPOSTING MIXING DISPOSAL
100 66 0152  MODEL               ECONOMICS OF LIQUID-MANURE DISPOSAL FROM CONFINED LIVESTOCK KEYWORDS  COD BOD COST NUTR
200 69 0166  MODEL               ANALYSIS FOR OXYGEN TRANSFER COEFFICIENTS IN ROTOR AERATION SYSTEMS  KEYWORDS  EQUATION
200 71 0781  MODEL               ANALYSIS OF DUCK FARM WASTE TREATMENT SYSTEMS  KEYWORDS  MODEL PHOSPHORUS BOD DUCK AERA
100 70 0738  MODELING            MODELING FEEDLOT POLLUTION I ANALOG SIMULATION  KEYWORDS RUNOFF MODELING FEEDLOT
200 66 0119  MODELS              BIOLOGICAL INTERRELATIONSHIPS BETWEEN FECES AND FLIES KEYWORDS  FILTH-FLIES CONFINEMENT
100 69 0095  MODEL-STUDIES       BIO-OXIDATION OF SWINE-WASTE BY THE ACTIVATED-SLUDGE PROCESS  KEYWORDS MODEL-STUDIES AN
100 70 1233  MODEL-STUDIES       LOSSES OF NITROGEN AND PHOSPHORUS FROM AGRICULTURAL LAND KEYWORDS WATER-POLLUTION-SOURC
200 71 0705  MODEL-STUDIES       A MATHEMATICAL SIMULATION OF BEEF ANIMALS-A REALITY WITH POTENTIAL  KEYWORDS  MATHEMATI
200 71 0791  MODEL-STUDIES       METEOROLOGICAL CONTROL OF MALODORS FROM LAND SPREADING OF LIVESTOCK WASTES  KEYWORDS  C
200 71 0799  MODEL-STUDIES       AGITATION IN LIQUID MANURE TANKS  KEYWORDS  LIQUID-WASTES PUMPS SLURRIES MODEL-STUDIES
300 71 1055  MODEL-STUDIES       ANNUAL REPORT OF ACTIVITIES DURING FISCAL YEAR 1971 KEYWORDS WATER-RESOURCES WATER-USER
300 71 1056  MODEL-STUDIES       AN ANALYSIS OF THE ECONOMIC IMPLICATIONS OF THE PERMIT SYSTEM OF WATER ALLOCATION KEYWO
300 71 1058  MODEL-STUDIES       DEVELOPMENT OF A MATHEMETICAL MODEL TO PREDICT THE ROLE OF  SURFACE RUNOFF AND GROUNDWA
500 71 0494  MODEL-STUDIES       A MODEL STUDY TO DETERMINE THE EFFECTS OF VENTILATION SYSTEMS UPON NH3 CONCENTRATIONS IN
200 70 0241  MOGDEN-FORMULA      SEWERS AND SEWAGE TREATMENT  KEYWORDS  LEGISLATION DESIGN-CRITERIA ACTIVATED-SLUDGE CAP
100 64 0333  MOISTURE            AEROBIC-DIGESTION, COMPOSTING  OF POULTRY-MANURE  KEYWORDS  AERATION WINDROW-METHOD PRE
100 65 0503  MOISTURE            THE MICROBIOLOGY OF BUILT UP POULTRY MANURE  KEYWORDS  PH BACTERIA ALKALINITY LABORATOR
100 67 0041  MOISTURE            THE EFFECTS OF FARMYARD MANURE ON MATRIC SUCTIONS PREVAILING IN A SANDY LOAM SOIL  KEYW
100 69 0040  MOISTURE            PHYSICAL AND BIOLOGICAL EVALUATION OF FIVE LITTER MATERIALS-ABSTRACT  KEYWORDS  POULTRY
200 69 0196  MOISTURE            THE INFLUENCE OF VARIOUS FACTORS ON POULTRY LITTER COMPOSITION  KEYWORDS  NITROGEN CARB
400 70 0091  MOISTURE            MOISTURE INCREASES MANURE ODORS  KEYWORDS  POULTRY AMMONIA  HYDROGEN-SULFIDE CHROMATOGR
400 70 0577  MOISTURE            BLOCK DRYING OF CHICKEN MANURE  KEYWORDS  DRYING POULTRY MOISTURE CONTENT ODOR NITROGEN
600 72 1031  MOISTURE            ELECTRIC IN-HOUSE DRYING OF POULTRY WASTE KEYWORDS POULTRY ODOR NUTRIENTS RECYCLING FAR
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100 64 0371  MOISTURE-CONTENT      THIN-SPREADING OF SLURRIED-MANURES  KEYWORDS  DRYING LAYERS MOISTURE-CONTENT SOLIDS-PER
100 65 0377  MOISTURE-CONTENT      EFFECTS OF ORGANIC-MANURES ON SOILS AND CROPS  KEYWORDS  ORGANIC-MATTER FERTILIZERS SOI
100 65 0697  MOISTURE-CONTENT      THE MICROBIOLOGY OF BUILT UP POULTRY LITTER KEYWORDS MICROBIOLOGY BACTERIA FARM-WASTES
100 68 0337  MOISTURE-CONTENT      A REVIEW OF POULTRY-WASTE-DISPOSAL POSSIBILITIES  KEYWORDS  BOD N P K MOISTURE-CONTENT
100 68 0502  MOISTURE-CONTENT      MANURE-PRODUCTION BY BROILERS  KEYWORDS  POULTRY-LITTER MOISTURE-CONTENT CRUDE-PROTEIN
100 70 0031  MOISTURE-CONTENT      VOLITILIZATION AND NITRIFICATION OF NITROGEN FROM URINE UNDER SIMULATED CATTLE FEEDLOT
100 70 0691  MOISTURE-CONTENT      THE EFFECT OF HUMIDITY AND FLOORING TYPE ON THE MOISTURE CONTENT OF BROILER EXCREMENTS
200 69 0165  MOISTURE-CONTENT      AEROBIC DECOMPOSITION OF SOLID WASTES FROM CATTLE FEEDLOTS  KEYWORDS  MOISTURE-CONTENT
200 69 0197  MOISTURE-CONTENT      REMOVAL OF WATER FROM ANIMAL MANURES  KEYWORDS  POULTRY ODOR MOISTURE-CONTENT WEIGHT VO
200 70 0323  MOISTURE-CONTENT      AGRICULTURE-WASTE RESEARCH-NEEDS  KEYWORDS  POULTRY ODOR LIQUID-HANDLING SHUD MOISTURE-
200 71 0703  MOISTURE-CONTENT      FEEDLOT WASTE MANAGEMENT  SOME SOLUTIONS TO THE PROBLEM  KEYWORDS  MOISTURE-CONTENT SAM
200 71 0813  MOISTURE-CONTENT      THROUGH-CIRCULATION DRYING OF MANURE IN SUPERHEATED STEAM KEYWORDS  MOISTURE-CONTENT OD
300 69 0633  MOISTURE-CONTENT      THE QUANTITATIVE DETERMINATION OF THE ODOR STRENGTH OF CHICKEN MANURE  KEYWORDS  WASTE
300 70 0206  MOISTURE-CONTENT      DRYING ANIMAL WASTE  KEYWORDS POULTRY CATTLE HOGS MOISTURE-CONTENT NUTRIENTS DENSITY CO
300 71 0630  MOISTURE-CONTENT      A COMPILATION OF SOME SAMPLES OF DRIED POULTRY WASTE ANALYZED BY DR  E  J  BENNE  KEYWO
300 72 1264  MOISTURE-CONTENTS     PRINCIPLES OF FEEDLOT ODOR CONTROL KEYWORDS AIR-POLLUTION FEED-LOTS FARM-WASTES AEROBIC
400 70 0109  MOISTURE-CONTENT      SOME CAUSES OF WET POULTRY MANURE  KEYWORDS  MOISTURE-CONTENT WATER-CONSUMPTION STRAINS
600 70 0080  MOISTURE-CONTENT      FLOW PROPERTIES OF ANIMAL WASTE SLURRIES  KEYWORDS  VISCOSITY FLOW-CHARACTERISTICS SHEA
600 72 1076  MOISTURE-CONTENT      HIGH-TEMPERATURE HIGH-PRESSURE EXTRUSION OF CHICKEN EXCRETA KEYWORDS FARM-WASTES POULTR
600 72 1169  MOISTURE-CONTENT      CROP YIELDS FROM LAND RECEIVING LARGE MANURE APPLICATIONS KEYWORDS APPLICATION-METHODS
600 73 1075  MOISTURE-CONTENT      THE EFFECT OF RATION ON ENGINEERING PROPERTIES OF BEEF CATTLE MANURE KEYWORDS
600 72 1262  MOISTURE-DEFICIT      CLIMATE AND THE SELECTION OF A BEEF WASTE MANAGEMENT SYSTEM KEYWORDS CLIMATES FEED-LOTS
200 66 0141  MOISTURE-DISTRIBUT    REMOVAL OF MOISTURE FROM POULTRY WASTE BY ELECTRO-OSMOSIS PART 1 KEYWORDS  DEWATERING E
100 71 0476  MOLD                  THE MICROFLORA OF SOUTHERN OHIO POULTRY LITTER  KEYWORDS FUNGUS PH BACTERIA MOLD POULTR
100 71 1212  MONTANA               EFFECTS OF MULTIPLE USE ON WATER QUALITY OF HIGH MOUNTAIN WATERSHEDS BACTERIOLOGICAL IN
200 69 0553  MONTANA               STATUS REPORT OF MONTANA S PROGRAM TO CONTROL POLLUTION FROM ANIMAL FEEDLOTS  KEYWORDS
200 70 1175  MONTANA               ANIMAL WASTE DISPOSAL KEYWORDS WATER-LAW REGULATION PERMITS FEED-LOTS WASTE-DISPOSAL
200 73 1189  MONTANA               A FEEDER LOOKS AT ANIMAL WASTE DISPOSAL KEYWORDS FARM-WASTES WASTE-DISPOSAL FEED-LOTS F
200 64 1240  MORPHOLOGY            THE PHYSIOLOGY OF THE COLIFORM GROUP KEYWORDS  BACTERIA COLIFORMS POLLUTANTS SANITARY-E
100 71 0461  MORTALITY             FUMIGATION AND REUSE OF BROILER LITTER KEYWORDS  POULTRY PERFORMANCE MORTALITY WEIGHT-G
100 69 0374  MORTALITY             ARTHROPOD-PREDATORS OF IMMATURE DIPTERA DEVELOPING IN POULTRY-DROPPINGS IN NORTHERN CAL
100 70 1090  MORTALITY             COUMAPHOS AS A FEED ADDITIVE FOR THE CONTROL OF HOUSE FLY LARVAE IN COW MANURE KEYWORDS
100 71 1092  MORTALITY             EFFECT OF BACILLUS THURINGIENSIS IN CATTLE MANURE ON HOUSE  FLY LARVAE KEYWORDS
200 69 0165  MORTALITY             WASTE DISPOSAL MANAGEMENT  KEYWORDS  NITROGEN WATER-POLLUTION INCINERATION STORAGE MORT
200 69 0187  MORTALITY             CAGED LAYER PERFORMANCE IN PENS WITH OXIDATION DITCHES AND LIQUID MANURE STORAGE TANKS
500 68 1259  MOSQUITOES            WASTE STABILIZATION PONDS FOR AGRICULTURAL WASTES KEYWORDS WASTE-TREATMENT STABILIZATIO
100 70 0026  MOTILITY-FLASK        A RAPID AND SIMPLE METHOD FOR THE DETECTION AND ISOLATION OF SALMONELLA FROM MIXED CULT
200 72 1014  MOUNDING              APPLICATION UTILIZATION AND DISPOSAL OF LIVESTOCK WASTE KEYWORDS WASTE-DISPOSAL WASTE-T
200 72 1017  MOUNDING              WASTE MANAGEMENT AND ANIMAL PERFORMANCE KEYWORDS FEED-LOTS FARM-WASTES WASTE-TREATMENT
200 72 1023  MOUNDING              CHARACTERISTICS OF LIVESTOCK WASTE AND RUNOFF KEYWORDS FARM-WASTES PHYSICAL-PROPERTIES
100 71 1212  MOUNTAINS             EFFECTS OF MULTIPLE USE ON WATER QUALITY OF HIGH MOUNTAIN WATERSHEDS BACTERIOLOGICAL IN
100 71 0318  MOVEMENT              RUNOFF, SOLID WASTES, AND NITRATE MOVEMENT ON BEEF FEEDLOTS KEYWORDS  COD BOD DO SOIL-C
200 71 0854  MOVEMENT              MOVEMENT OF POLLUTANT PHOSPHORUS IN SATURATED SOILS  KEYWORD  FERTILIZERS NUTRIENT-REMO
500 70 0404  MOVEMENT              MOVEMENT OF AGRICULTURAL-POLLUTANTS WITH GROUNDWATER  KEYWORDS WATER-POLLUTION ZONE-OF-
700 70 1256  MOVEMENT              MOVEMENT OF POLLUTANT PHOSPHORUS IN SATURATED SOILS KEYWORDS PHOSPHATES SOIL-CONTAMINAT
200 66 0144  MPN                   TREATMENT OF DUCK WASTES AND THEIR EFFECTS ON WATER QUALITY KEYWORDS  COLIFORMS BOD POU
100 64 0343  MUC                   BOVINE-SALMONELLOSIS IN A FEEDLOT OPERATION  KEYWORDS  MUD  ANTIBIOTICS STAGNANT-WATER
400 71 1139  MUD                   HOW WEATHER AFFECTS FEEDLOT PERFORMANCE KEYWORDS MUD RAIN WIND FEED-LOTS FARM-WASTES WE
100 71 0484  MUD-WATER-INTERFAC    RELATIONSHIPS OF SALMONELLA TO FECAL COLIFORMS IN BOTTOM SEDIMENTS  KEYWORD  INDICATORS
300 26 1204  MUNCIPAL-WASTES       OHIO STOCK FOOD COMPANY V GINTLING STREAM POLLUTION BY UPPER RIPARIAN HOG FARM KEYWORDS
100 68 0306  MUNICIPAL             ANAEROBIC DIGESTION FAILURES  KEYWORDS DIGESTION SLUDGE DISPOSAL AMMONIUM ALKALINE BUIL
200 66 0140  MUNICIPAL             DEWATERING CHICKEN MANURES BY VACUUM FILTRATION  KEYWORDS DEWATERING VACUUM SEWAGE SLUD
200 73 1083  MUNICIPAL-REFUSE      CONTINUOUS SOLID WASTE RETORT-FEASIBILITY STUDY KEYWORDS CATTLE FARM-WASTES WASTE-DISPO
100 67 1218  MUNICIPAL-WASTES      FUTURE WATER QUALITY DESIGN KEYWORDS WATER-QUALITY WATER-POLLUTION WATER-QUALITY-MANAGE
200 68 1242  MUNICIPAL-WASTES      THE MOVEMENT OF DISEASE PRODUCING ORGANISMS THROUGH SOILS KEYWORDS WATER-REUSE PATHOGEN
200 68 1242  MUNICIPAL-WASTE-RE    THE MOVEMENT OF DISEASE PRODUCING ORGANISMS THROUGH SOILS KEYWORDS WATER-REUSE PATHOGEN
200 68 1244  MUNICIPAL-WASTES      SURVIVAL OF PATHOGENS AND RELATED DISEASE HAZARDS KEYWORDS HAZARDS IRRIGATION-WATER REC
200 69 1117  MUNICIPAL-WASTES      WATER POLLUTION BY NUTRIENTS--SOURCES EFFECTS AND CONTROL PAPERS PRESENTED AT 1966 ANNU
200 69 1167  MUNICIPAL-WASTES      AGRICULTURAL WASTES  A MANAGEMENT PROBLEM KEYWORDS POLLUTION WASTE-DISPOSAL AGRICULTURA
200 70 0717  MUNICIPAL-WASTES      PROCESSING PLANT SANITATION AND ITS RELATIONSHIP TO WASTE MANAGEMENT  KEYWORDS  BOD SEW
200 73 1082  MUNICIPAL-WASTES      COSTS FOR LARGE SCALE CONTINUOUS PYROLYSIS OF SOLID WASTES  KEYWORDS SOLID-WASTES COSTS
400 69 1225  MUNICIPAL-WASTES      CONSERVING RESOURCES AND MAINTAINING A QUALITY ENVIRONMENT  KEYWORDS WATER-RESOURCE-DEV
200 69 0160  MUNINCIPAL-WASTES     EFFECTS OF WATER QUALITY STANDARDS ON THE REQUIREMENTS FOR  TREATMENT OF ANIMAL WASTES
400 69 0419  MUSCA                 DIGESTION OF POULTRY MANURE BY DIPTERA  KEYWORDS  WASTE TREATMENT WASTE DISPOSAL FARM W
100 70 0082  MUSCA-DOMESTICA       HOUSE FLY PUPAE AS FOOD FOR POULTRY  KEYWORDS  FEEDS NUTRIENTS MUSCA-DOMESTICA
100 70 1090  MUSCA-DOMESTICA-L     COUMAPHOS AS A FEED ADDITIVE FOR THE CONTROL OF HOUSE FLY LARVAE IN COW MANURE KEYWORDS
100 71 1092  MUSCA-DOMESTICA-L     EFFECT OF BACILLUS THURINGIENSIS IN CATTLE MANURE ON HOUSE  FLY LARVAE KEYWORDS
100 72 1199  MUSCLE                IMPROVED PROCEDURES FOR THE DETERMINATION OF OXYTETRACYCLINE IN MILK MILK PRODUCTS CHIC
100 72 1215  MUSCLE                AUTOMATED COMBUSTION VERSUS DIGESTION FOR TRITIUM MEASUREMENT IN BIOLOGICAL SAMPLES  KE
100 70 1111  MUSSELS               POLYCHLORINATED BIPHENYLS KEYWORDS CHLORINATED-HYDROCARBON-PESTICIDES FOOD-CHAINS PESTI
300 70 1104  MYCOBACTERIUM         FISH AS POTENTIAL VECTORS OF HUMAN BACTERIAL DISEASES KEYWORDS DISEASES VECTROS-BIOLOGY
100 71 1212  MYSTIC-WATERSHED      EFFECTS OF MULTIPLE USE ON WATER QUALITY OF HIGH MOUNTAIN WATERSHEDS BACTERIOLOGICAL IN
100 64 0333  N                     AEROBIC-DIGESTION, COMPOSTING  OF POULTRY-MANURE  KEYWORDS  AERATION WINDROW-METHOD PRE
100 64 0474  N                     PROPERTIES AND PUMPING CHARACTERISTICS OF HOG WASTES KEYWORDS  SOLIDS N DIAPHRAGM-PUMP
100 65 0377  N                     EFFECTS OF ORGANIC-MANURES ON SOILS AND CROPS  KEYWORDS  ORGANIC-MATTER FERTILIZERS SOI
100 68 0337  N                     A REVIEW OF POULTRY-WASTE-DISPOSAL POSSIBILITIES  KEYWORDS  BOD N P K MOISTURE-CONTENT
100 69 0061  N                     SURFACE RUNOFF AND NUTRIENT LOSSES OF FENNIMORE WATERSHEDS  KEYWORDS  FERTILIZERS N P K
100 70 0042  N                     STREAM ENRICHMENT FROM FARM OPERATIONS  KEYWORDS  FERTILIZER N P K NUTRIENT-LOSSES PREC
200 70 0214  N                     RELATIONSHIP OF AGRICULTURE TO SOIL AND WATER POLLUTION  KEYWORDS  BOD COD FERTILIZERS
200 70 0226  N                     A BALANCE-SHEET-METHOD OF DETERMINING THE CONTRIBUTION OF AGRICULTURAL-WASTES TO SURFAC
300 70 0475  N                     LIQUID DIGESTED SEWAGE SLUDGE GIVES FIELD CROPS NECESSARY NUTRIENTS  KEYWORDS  IRRIGATI
400 70 0070  N                     SOIL AS AN ANIMAL-WASTE DISPOSAL-MEDIUM  KEYWORDS  N P K SOIL-PROPERTIES SOIL-SURVEYS F
600 70 0254  N                     AEROBIC STABILIZATION OF BEEF FEEDLOT WASTE  KEYWORDS  C N  HOUSEFLY COMPOSTING ANAEROB
600 70 0258  N                     GAS PRODUCTION FROM BEEF CATTLE WASTES  KEYWORDS  ANAEROBIC-DIGESTION GASES COD COMPOST
200 69 0169  NAOH                  INFLUENCE OF CHEMICAL TREATMENTS UPON DIGESTIBILITY OF RUMINANT FECES  KEYWORDS  CATTLE
200 70 1050  NATIONAL-ENVIRONME    THE LEGAL FUTURE  NEW THEORIES OF ENVIRONMENTAL PROTECTION  KEYWORDS ENVIRONMENTAL-SANI
200 69 0158  NATIONAL-POLICY       REFLECTIONS ON POLLUTION CONTROL  KEYWORDS  WATER-QUALITY COST-BENEFIT-RATIO ENVIRONMEN
300 67 1250  NATIVE-GRASSES        DISTRIBUTION OF NITRATES AND OTHER WATER POLLUTANTS UNDER FIELDS AND CORRALS IN THE MID
200 70 1050  NATURAL-RESOURCES     THE LEGAL FUTURE  NEW THEORIES OF ENVIRONMENTAL PROTECTION  KEYWORDS ENVIRONMENTAL-SANI
100 66 0506  NATURE                CATTLE FEEDLOT RUNOFF IT S NATURE AND VARIATION  KEYWORDS BOD COD FEEDLOT RUNOFF NATURE
100 71 0509  NATURE                THE METAL COMPLEXING CAPACITY AND THE NATURE OF THE CHELATING LIGANDS OF WATER EXTRACT
200 70 0235  NATURE                ORIGINS AND NATURE OF FARM WASTES  KEYWORDS  DISPOSAL COSTS LEGAL-ASPECTS ECONOMICS UK
100 72 1097  NEBRASKA              NITRATE CONCENTRATIONS IN GROUNDWATER BENEATH A BEEF CATTLE FEEDLOT KEYWORDS
200 70 0224  NEBRASKA              HYDROLOGIC-STUDIES FOR EVALUATION OF THE POLLUTION-POTENTIAL OF FEEDLOTS IN EASTERN NEB
200 72 1010  NEBRASKA              PROCEEDINGS  LIVESTOCK WASTE MANAGEMENT RESEARCH REVIEW KEYWORDS LIVESTOCK FARM-WASTES
200 72 1011  NEBRASKA              NATIONAL LIVESTOCK WASTE MANAGEMENT PROGRAM KEYWORDS FARM-WASTE FEED-LOTS GROUNDWATER R
200 72 1013  NEBRASKA              POLLUTION OF AIR WATER AND SOIL BY LIVESTOCK KEYWORDS AIR-POLLUTION WATER-POLLUTION SOI
200 72 1014  NEBRASKA              APPLICATION UTILIZATION AND DISPOSAL OF LIVESTOCK WASTE KEYWORDS WASTE-DISPOSAL WASTE-T
200 72 1015  NEBRASKA              DESIGN AND MANAGEMENT OF RUNOFF CONTROL SYSTEMS KEYWORDS FARM-WASTES FEED-LOTS CATTLE R
200 72 1017  NEBRASKA              WASTE MANAGEMENT AND ANIMAL PERFORMANCE KEYWORDS FEED-LOTS FARM-WASTES WASTE-TREATMENT
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200 72 1014  NEBRASKA           EDUCATION ACTION AND REGULATORY PROBLEMS OF ANIMAL WASTE MANAGEMENT KEYWORDS
200 72 1019  NEBRASKA           PROBLEMS OF ANIMAL WASTE MANAGEMENT FROM THE LIVESTOCK FEEDER VIEWPOINT KEYWORDS
200 72 1022  NEBRASKA           RESEARCH NEEDS FOR THE DESIGN AND MANAGEMENT OF BEEF FEEDLOT RUNOFF-CONTROL SYSTEMS KEY
200 72 1024  NEBRASKA           WASTE-INDUCED PROBLEMS OF HOUSED LIVESTOCK KEYWORDS LIVESTOCK SHEEP CATTLE HOGS NEBRASK
200 72 1025  NEBRASKA           OTHER RESEARCH NEEDS KEYWORDS FARM-WASTES PROTEINS RUNOFF FEED-LOTS WASTE-DISPOSAL
200 72 1029  NEBRASKA           CONCLUDING COMMENTS KEYWORDS FARM-WASTES CROP-PRODUCTION LIVESTOCK SOILS MARKETING  WAS
300    1105  NEBRASKA           RULE AND REGULATION FOR THE REGISTRATION OF FEEDLOTS KEYWORDS NEBRASKA WATER-POLLUTION-
300 71 0689  NEBRASKA           WASTE MANAGEMENT FOR FEEDLOTS  KEYWORD  NEBRASKA LIVESTOCK RUNOFF FEDERAL-GOVERNMENT MA
300 71 1008  NEBRASKA           ANIMAL WASTE DISPOSAL AND CONTROL OF FEEDLOT RUNOFF KEYWORDS FEED-LOTS WASTE-DISPOSAL R
400 71 1135  NEBRASKA           ENGINEER SAYS FEEDERS CAN HANDLE MOST POLLUTION CONTROL PRACTICES KEYWORDS
400 71 1174  NEBRASKA           LIQUID WASTE SEEPS FROM ONE BASIN TO ANOTHER KEYWORDS AQUIFER CATTLE FARM-WASTES FEED-L
400 72 1032  NEBRASKA           NEBRASKA IS NO ONE KEYWORDS FEED-LOTS CATTLE FARM-WASTES ODOR IRRIGATION LABORATORIES
400 73 1158  NEBRASKA           DO YOU HAVE TO MOVE EM OR CAN YOU LEAVE EM KEYWORDS FEED-LOTS RUNOFF WASTE-STORAGE WAST
200 72 1018  NEBRASKA-LIVESTOCK EDUCATION ACTION AND REGULATORY PROBLEMS OF ANIMAL WASTE MANAGEMENT KEYWORDS
100 70 0368  NEEDS              AGRICULTURE-WASTE RESFARCH-NEEDS  KEYWORDS  POULTRY DISPOSAL ODOR COSTS DRYING EQUIPMEN
100 65 0470  NEIGHBORS          CONTROLLING ODORS FROM CATTLE FEEDLOTS AND MANURE DEHYDRATION OPERATIONS  KEYWORDS  LEG
100 70 0368  NEIGHBORS          AGRICULTURE-WASTE RESEARCH-NEEDS  KEYWORDS  POULTRY DISPOSAL ODOR COSTS DRYING EQUIPMEN
400 70 0113  NEIGHBORS          LOCATING A POULTRY ENTERPRISE  KEYWORDS  NEIGHBORS EGGS
200 71 0845  NEMATODES          CATTLE MANURE AS FEED FOR CATTLE  KEYWORD  RECYCLING ANIMAL-PATHOLOGY MICROORGANISMS NE
100 71 0451  NETHERLANDS        REDUCTION OF SALMONELLA IN COMPOST IN A HOG FATTENING FARM  OXIDATION VAT  KEYWORDS  AE
300 71 1100  NEUTRON-ACTIVATION DETERMINATION ON MERCURY IN SAMPLES FROM THE DUTCH ENVIRONMENT  KEYWORDS MERCURY NEUTRO
100 68 0287  NEW                METHODS FOR DISPOSAL OF POULTRY MANURE  KEYWORDS NEW ZEALAND IRRIGATION DRYING STORAGE
600 70 0080  NEWTONIAN-FLUIDS   FLOW PROPERTIES OF ANIMAL WASTE SLURRIES  KEYWORDS  VISCOSITY FLOW-CHARACTERISTICS SHEA
700 71 1120  NEW-JERSEY         SOURCES OF PHOSPHATE AMMONIUM AND NITRATE CONTAMINATION IN  SOME CENTRAL NEW JERSEY STR
400 71 1196  NEW-MEXICO         CATTLE FEEDERS MUST COMPLY WITH ANTI POLLUTION LAWS KEYWORDS LEGAL-ASPECTS POLLUTION-AB
600 72 1031  NEW-YORK           ELECTRIC IN-HOUSE DRYING OF POULTRY WASTE KEYWORDS POULTAY ODOR NUTRIENTS RECYCLING FAR
100 69 0445  NEW-ZEALAND        EFFLUENT DISPOSAL  KEYWORDS  DAIRY NEW-ZEALAND EFFLUENT
700 72 1049  NISHNABOTNA-RIVER- ECONOMICS OF WATER QUALITY MANAGEMENT  EXEMPLIFIED BY SPECIFIED POLLUTANTS IN AGRICULTU
100 69 0052  NITRATE            NITROGEN CONTAMINATION OF GROUNDWATER BY BARNYARD LEACHATES KEYWORDS PIEZOMETERS FLOW-N
100 70 0031  NITRATE            VOLITILIZATION AND NITRIFICATION OF NITROGEN FROM URINE UNDER SIMULATED CATTLE FEEDLOT
100 71 0450  NITRATE            NITRATE AND SALT IN SOILS AND GROUND-WATERS FROM LAND DISPOSAL OF DAIRY MANURE  KEYWORD
200 69 0423  NITRATE            2 ND COMPENDIUM OF ANIMAL WASTE MANAGEMENT KEYWORDS  RAINFALL-RUNOFF EQUIPMENT DESIGN-D
200 70 0216  NITRATE            GROUNDWATER QUALITY AND FLUCTUATIONS IN A SHALLOW UNCONFINED AQUIFER UNDER A LEVEL FEED
200 70 0221  NITRATE            LAND-DISPOSAL OF DAIRY-FARM-WASTE  KEYWORDS EFFLUENT NITRATE PHOSPHATE GROUNDWATER WATE
200 70 0222  NITRATE            THE NITROGEN-CYCLE OF A DAIRY FARM  KEYWORDS NUTRIENTS FERTILIZATION FOLIAR-APPLICATION
200 70 0223  NITRATE            NITROGEN-TRANSFORMATIONS AND PLANT-GROWTH AS AFFECTED BY APPLYING LARGE AMOUNTS OF CATT
200 71 0279  NITRATE            POLLUTION - HOW MUCH OF A PROBLEM COMES FROM FERTILIZERS KEYWORDS  NITRATE EUTROPHICATI
300 65 0739  NITRATE            NITRATE AND WATER  KEYWORD  FERTILIZERS LEGUMES MISSOURI ALFALFA LIVESTOCK NITRATE
300 65 0757  NITRATE            AEROBIC TREATMENT OF SWINE WASTE  KEYWORDS  CONFINEMENT-PENS AERATION BOD COD AMMONIA N
300 67 0711  NITRATE            THE NITRATE HAZARD IN WELL WATER  KEYWORDS  WELL DATA FEED-LOTS WELL-REGULATIONS PERCOL
300 71 0099  NITRATE            REMOVAL OF NITRATE BY AN ALGAL SYSTEM KEYWORDS REMOVAL NITRATE ALGAL-SYSTEM
500 70 0405  NITRATE            EFFECTS OF AGRICULTURAL-POLLUTION ON EUTROPHICATION KEYWORDS NITROGEN PHOSPHOROUS NITRA
100 62 1220  NITRATES           WATER POLLUTION RESULTING FROM AGRICULTURAL ACTIVITIES KEYWORDS WATER-POLLUTION-SOURCES
100 67 0076  NITRATES           NITRATE AND OTHER WATER POLLUTANTS UNDER FIELDS AND FEEDLOTS  KEYWORDS  NITRATES WATER-
100 68 1121  NITRATES           WATER POLLUTION FROM LAND RUNOFF KEYWORDS RUNOFF WATER-POLLUTION INFILTRATION SEDIMENTS
100 69 1198  NITRATES           CHEMICAL AND DETRITAL FEATURES OF PALOUSE RIVER IDAHO RUNOFF FLOWARE KEYWORDS
100 70 0049  NITRATES           USE OF SOIL TO TREAT ANAEROBIC LAGOON EFFLUENT RENOVATION AS A FUNCTION OF DEPTH AND AP
100 70 1037  NITRATES           NITROGEN IN AGRICULTURE  THE PROBLEMS AND THE EFFECT ON THE ENVIRONMENT KEYWORDS
100 70 1041  NITRATES           STATISTICAL EVALUATION OF SALINITY AND NITRATE CONTENT AND  TRENDS BENEATH URBAN AND AG
100 70 1051  NITRATES           POLLUTION POTENTIAL OF SALMONID FISH HATCHERIES KEYWORDS FISH-HATCHERIES SALMONIDS SOUR
100 70 1195  NITRATES           AGRICULTURAL POLLUTION OF WATER BODIES KEYWORDS WATER-POLLUTION FARMS LIVESTOCK PHOSPHO
100 70 1233  NITRATES           LOSSES OF NITROGEN AND PHOSPHORUS FROM AGRICULTURAL LAND KEYWORDS WATER-POLLUTION-SOURC
100 71 1038  NITRATES           CONCENTRATIONS OF POLLUTANTS IN AGRICULTURAL RUNOFF KEYWORDS LAKES WATER-QUALITY TEXAS
100 71 1039  NITRATES           NUTRIENTS IN STREAMS DRAINING WOODLAND AND FARMLAND NEAR COSHOCTON OHIO KEYWORDS
100 71 1197  NITRATES           NUTRIENT LOSSES FROM AGRICULTURAL LAND KEYWORDS EUTROPHICATION AGRICULTURAL-RUNOFF FERT
100 71 1236  NITRATES           MIGRATION OF POLLUTANTS IN A GLACIAL OUTWASH ENVIRONMENT KEYWORDS PATH-OF-POLLUTANTS GL
100 72 1097  NITRATES           NITRATE CONCENTRATIONS IN GROUNDWATER BENEATH A BEEF CATTLE FEEDLOT KEYWORDS
100 72 1193  NITRATES           CHARACTERISTICS OF MILKING CENTER WASTE EFFLUENT FROM NEW YORK STATE DAIRY FARMS KEYWOR
100 70 1237  NITRATES           POLLUTION POTENTIAL OF SALMONID FISH HATCHERIES KEYWORDS SOURCES FISH-HATCHERIES SALMON
200 69 0168  NITRATES           AEROBIC DIGESTION OF DILUTED ANIMAL MANURE IN CLOSED SYSTEMS-TEMPORARY EXPEDIENT OR LON
200 69 0174  NITRATES           THE NITROGEN PROBLEM IN THE LAND DISPOSAL OF LIQUID MANURE  KEYWORDS  GROUNDWATER NITRA
200 69 0184  NITRATES           TREATMENT OF WASTES FROM BEEF CATTLE FEEDLOTS-FIELD RESULTS  KEYWORDS  ANAEROBIC-CONDIT
200 69 0462  NITRATES           THE EFFECTS OF FARM WASTES ON THE POLLUTION OF NATURAL WATERS  KEYWORD  GROUNDWATER NUT
200 69 0521  NITRATES           WATER-QUALITY PROBLEMS  KEYWORDS  WATER-POLLUTION NITROGEN  PHOSPHORUS NITRATES BASE-FL
200 69 0534  NITRATES           COLUMBIA-COUNTY PROGRAM  KEYWORDS  POLLUTION-ABATEMENT ODOR ZONING NITRATES PROGRAM
200 69 0548  NITRATES           RESEARCH ON ABATEMENT OF POLLUTION AND MANAGEMENT OF ORGANIC WASTES FROM CATTLE FEEDLOT
200 69 0696  NITRATES           QUALITY OF EFFLUENT FROM SWINE PRODUCTION AREAS  KEYWORD  SURFACE-WATERS DISCHARGE LAGO
200 70 0217  NITRATES           POLLUTION FACTORS ASSOCIATED WITH EXCESSIVE POULTRY-LITTER  MANURE  APPLICATION IN ARKA
200 70 0670  NITRATES           ALTERNATIVES FOR THE TREATMENT AND DISPOSAL OF ANIMAL WASTES  KEYWORDS  FARM-WASTES CON
200 70 0727  NITRATES           EFFECTS OF AGRICULTURAL DISCHARGES INTO FRESH WATER LAKES  KEYWORD  DRAINAGE-EFFECTS DE
200 71 0826  NITRATES           CROP PRODUCTION AND SOIL ANALYSIS AS AFFECTED BY APPLICATIONS OF CATTLE FEEDLOT WASTE
200 71 0830  NITRATES           FATE OF INORGANIC FORMS OF N AND SALT FROM LAND-DISPOSED MANURES FROM DAIRIES  KEYWORDS
200 71 1094  NITRATES           AGRICULTURE AND POLLUTION--SOCIO-ECONOMIC ASPECTS KEYWORDS WATER-POLLUTION ECONOMICS SU
200 71 1099  NITRATES           SUMMER CONFERENCE OF SOCIETY FOR APPLIED BACTERIOLOGY KEYWORDS MICROORGANISMS WATER-POL
200 71 1234  NITRATES           SOME OBSERVATIONS ON THE LIMNOLOGY OF A POND RECEIVING ANIMAL WASTES KEYWORDS
200 71 1252  NITRATES           NITRATE POLLUTION OF WATER KEYWORDS WATER-POLLUTION-SOURCES GROUNDWATER SURFACE-WATERS
200 72 1013  NITRATES           POLLUTION OF AIR WATER AND SOIL BY LIVESTOCK KEYWORDS AIR-POLLUTION WATER-POLLUTION SOI
200 72 1014  NITRATES           APPLICATION UTILIZATION AND DISPOSAL OF LIVESTOCK WASTE KEYWORDS WASTE-DISPOSAL WASTE-T
200 72 1016  NITRATES           CHARACTERISTICS OF ANIMAL WASTES AND RUNOFF KEYWORDS CONDUCTIVITY FARM-WASTES RUNOFF TH
200 72 1020  NITRATES           POLLUTION OF AIR WATER AND SOIL BY LIVESTOCK KEYWORDS AIR-POLLUTION WATER-POLLUTION SOI
200 72 1021  NITRATES           APPLICATION UTILIZATION AND DISPOSAL OF LIVESTOCK WASTES KEYWORDS FARM-WASTES FEED-LOTS
200 72 1108  NITRATES           EFFECTS OF AGRICULTURAL LAND USE ON THE QUALITY OF SURFACE  RUNOFF KEYWORDS
300    1077  NITRATES           SOIL CONDITIONS UNDER FEEDLOTS AND ON LAND TREATED WITH LARGE AMOUNTS OF ANIMAL WASTES
300 67 1250  NITRATES           DISTRIBUTION OF NITRATES AND OTHER WATER POLLUTANTS UNDER FIELDS AND CORRALS IN THE MID
300 68 1122  NITRATES           NITROGEN CYCLE IN SURFACE AND SUBSURFACE WATERS KEYWORDS DOMESTIC-ANIMALS WASTES FERTIL
300 70 0414  NITRATES           THE POLLUTION POTENTIAL OF CATTLE FEEDING OPERATIONS  KEYWORD  CONFINEMENT-PENS GROUNDW
300 70 0475  NITRATES           LIQUID DIGESTED SEWAGE SLUDGE GIVES FIELD CROPS NECESSARY NUTRIENTS  KEYWORDS  IRRIGATI
300 70 1059  NITRATES           NITRATE ACCUMULATION IN KANSAS GROUNDWATER KEYWORDS NITRATES GROUNDWATER FERTILIZATION
300 71 0466  NITRATES           INFILTRATION RATES AND GROUNDWATER QUALITY BENEATH CATTLE FEEDLOTS TEXAS HIGH PLAINS KE
300 71 0639  NITRATES           USING SOIL FILTRATION TO REDUCE POLLUTION POTENTIAL OF LAGOON EFFLUENT ENTERING GROUNDW
300 71 1008  NITRATES           ANIMAL WASTE DISPOSAL AND CONTROL OF FEEDLOT RUNOFF KEYWORDS FEED-LOTS WASTE-DISPOSAL R
300 71 1106  NITRATES           MANAGING OUR ENVIRONMENT KEYWORDS MANAGEMENT ENVIRONMENT AGRICULTURE WATER-POLLUTION-CO
300 71 1107  NITRATES           WATER POLLUTION CONTROL LEGISLATION AGRICULTURAL RUNOFF PART 6  KEYWORDS AGRICULTURAL-C
400 65 1127  NITRATES           WHY NITRATES IN WATER SUPPLIES KEYWORDS NITRATES FEED-LOTS FERTILIZERS FARM-WASTES MISS
400 65 1141  NITRATES           NITRATES DANGER FOR HUMANS, TOO KEYWORDS FEED-LOTS WATER-WELLS NITRATES FARM-WASTES MIS
400 69 0016  NITRATES           FERTILIZERS AND FEEDLOTS - WHAT ROLE IN GROUNDWATER POLLUTION  KEYWORDS  FERTILIZERS SO
400 70 1176  NITRATES           ANIMAL WASTE DISPOSAL KEYWORDS ANIMAL-WASTES WASTE-DISPOSAL WATER-POLLUTION NITRATES
400 72 1166  NITRATES           HOW MUCH MANURE PER ACRE KEYWORDS ANIMAL-WASTES WASTE-DISPOSAL HOGS CATTLE
400 73 1063  NITRATES           AGRICULTURE AND ENVIRONMENT KEYWORDS PHOTOSYNTHESIS WATER-POLLUTION NITRATES PHOSPHATES
400 73 1073  NITRATES           NITRATE CONTENT OF PERCOLATES FROM MANURED LYSIMETERS KEYWORDS NITRATES FARM-WASTES LYS
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400 73 1168	NITRATES	CALIFORNIA WASTE PONDS ARE PASSING THE TEST KEYWORDS IRRIGATION-STORAGE-PONDS LEACHING
500 70 0392	NITRATES	SOURCES-OF-NITROGEN IN WATER-SUPPLIES KEYWORDS NITRATES GROUNDWATER SURFACE-WATER INF
500 70 0393	NITRATES	CHEMISTRY OF NITROGEN IN SOILS KEYWORDS NITRATES AMMONIUM FIXATION NITRITES LEACHING
500 70 0394	NITRATES	FERTILIZER-MANAGEMENT FOR POLLUTION-CONTROL KEYWORDS NITROGEN PHOSPHORUS SOIL-EROSION
500 71 1072	NITRATES	HUMAN AND ANIMAL WASTES AS FERTILIZERS KEYWORDS FARM-WASTES SEWAGE WASTE-DISPOSAL IRRIG
600 69 1239	NITRATES	DRAIN INSTALLATION FOR NITRATE REDUCTION KEYWORDS CALIFORNIA DRAINS INSTALLATION NITRAT
600 72 1167	NITRATES	CROP YIELDS FROM LAND RECEIVING LARGE MANURE APPLICATIONS KEYWORDS APPLICATION-METHODS
700 69 1067	NITRATES	ANALYSIS OF ANIMAL WASTE STORAGE AND LAND DISPOSAL SYSTEMS KEYWORDS FARM-WASTES ODOR W
700 71 1120	NITRATES	SOURCES OF PHOSPHATE AMMONIUM AND NITRATE CONTAMINATION IN SOME CENTRAL NEW JERSEY STR
400 65 1141	NITRATE-CYANOSIS	NITRATES DANGER FOR HUMANS, TOO KEYWORDS FEED-LOTS WATER-WELLS NITRATES FARM-WASTES MIS
300 70 0010	NITRATE-MOVEMENT	THE EFFECT OF ANIMAL-DENSITY AND SURFACE-SLOPE ON CHARACTERISTICS OF RUNOFF, SOLID-WAST
300 70 1059	NITRATE-MOVEMENT	NITRATE ACCUMULATION IN KANSAS GROUNDWATER KEYWORDS NITRATES GROUNDWATER FERTILIZATION
200 70 0720	NITRATE-POISONING	PROGRESS REPORT PASTURE FERTILIZATION USING POULTRY LITTER KEYWORDS FARM-WASTE WASTE-
200 71 1033	NITRIC-ACID	NITROGEN IN INDUSTRY KEYWORDS NITROGEN INDUSTRY FERTILIZERS WATER-POLLUTION AMMONIA FAR
100 70 0021	NITRIFICATION	EFFECT OF MANURE APPLICATION, AERATION, AND SOIL PH ON SOIL NITROGEN TRANSFORMATIONS AN
100 70 0050	NITRIFICATION	TREATMENT AND DISPOSAL OF ANIMAL WASTES KEYWORDS LAGOONS NUTRIENTS CONFINEMENT HOLDI
100 71 1220	NITRIFICATION	ALTERNATIVES FOR THE TREATMENT AND DISPOSAL OF ANIMAL WASTES KEYWORDS FARM-WASTES DISP
200 69 0179	NITRIFICATION	CHANGES IN COMPOSITION OF CONTINUOUSLY AERATED POULTRY MANURE WITH SPECIAL REFERENCE TO
200 70 0223	NITRIFICATION	NITROGEN-TRANSFORMATIONS AND PLANT-GROWTH AS AFFECTED BY APPLYING LARGE AMOUNTS OF CATT
200 70 0727	NITRIFICATION	EFFECTS OF AGRICULTURAL DISCHARGES INTO FRESH WATER LAKES KEYWORD DRAINAGE-EFFECTS DE
200 70 1115	NITRIFICATION	CONTROL OF NITROGEN FROM ANIMAL WASTE WATERS KEYWORDS FARM-WASTES NITROGEN-COMPOUNDS WA
200 71 0824	NITRIFICATION	AEROBIC TREATMENT OF LIQUID AND SOLID POULTRY MANURE KEYWORDS BIODEGRADATION NITRIFIC
200 71 0827	NITRIFICATION	A BARRIERED LANDSCAPE WATER RENOVATION SYSTEM FOR REMOVING PHOSPHATE AND NITROGEN FROM
200 71 0838	NITRIFICATION	NITROGEN TRANSFORMATION DURING AEROBIC DIGPSTION AND DENITRIFICATION OF DAIRY CATTLE WA
300 68 1122	NITRIFICATION	NITROGEN CYCLE IN SURFACE AND SUBSURFACE WATERS KEYWORDS DOMESTIC-ANIMALS WASTES FERTIL
300 69 1044	NITRIFICATION	IN SOIL PROFILES AND ON TRANSFORMATIONS OF SOIL NITROGEN KEYWORDS NITRIFICATION SOIL-NI
300 69 1124	NITRIFICATION	EFFECT OF VARIOUS FACTORS ON MOVEMENT OF NITRATE NITROGEN IN SOIL PROFILES AND ON TRANS
400 71 0305	NITRIFICATION	RETARDING EFFECT OF DESSICATION ON NITROGEN MINERALIZATION IN ORGANIC MANURES KEYWORDS
700 71 1120	NITRIFICATION	SOURCES OF PHOSPHATE AMMONIUM AND NITRATE CONTAMINATION IN SOME CENTRAL NEW JERSEY STR
200 71 0818	NITRIPICATIOT	THE ECONOMICS OF SWINE WASTE DISPOSAL KEYWORDS COSTS ECONOMIC-FEASIBILITY AEROBIC-TRE
100 72 1193	NITRITES	CHARACTERISTICS OF MILKING CENTER WASTE EFFLUENT FROM NEW YORK STATE DAIRY FARMS KEYWOR
200 69 0184	NITRITES	TREATMENT OF WASTES FROM BEEF CATTLE FEEDLOTS-FIELD RESULTS KEYWORDS ANAEROBIC-CONDIT
200 69 0482	NITRITES	THE EFFECTS OF FARM WASTES ON THE POLLUTION OF NATURAL WATERS KEYWORD GROUNDWATER NUT
500 70 0392	NITRITES	SOURCES-OF-NITROGEN IN WATER-SUPPLIES KEYWORDS NITRATES GROUNDWATER SURFACE-WATER INF
500 70 0393	NITRITES	CHEMISTRY OF NITROGEN IN SOILS KEYWORDS NITRATES AMMONIUM FIXATION NITRITES LEACHING
300 71 0512	NITROFURANS	FECAL-RESIDUES FROM FEED ADDITIVES POULTRY KEYWORDS POLLUTANTS DIETS ANTIBIOTICS NITR
100 63 0338	NITROGEN	DIGESTION-TESTS OF LIVESTOCK-WASTES KEYWORDS BOD COD CATTLE POULTRY SLUDGE-DIGESTION
100 64 0072	NITROGEN	A NOTE ON THE UTILIZATION BY CHICKENS OF ENERGY FROM FAECES KEYWORDS WHEAT SORGUUM NIT
100 65 1079	NITROGEN	UTILIZATION OF DIFFERENT LEVELS OF POULTRY LITTER NITROGEN BY SHEEP KEYWORDS
100 65 1219	NITROGEN	NITRATES IN THE ENVIROMENT KEYWORDS NITROGEN ATMOSPHERE BIOSPHERE FERTILIZATION NITROG
100 66 1080	NITROGEN	NITROGEN COMPOUNDS IN NATURAL WATER--A REVIEW KEYWORDS NITROGEN WATER FARM-WASTES GROUN
100 67 0713	NITROGEN	SOME AEROBIC DECOMPOSITION PROPERTIES OF DAIRY CATTLE MANUREKEYWORDS D COD CATTLE NITRO
100 68 0044	NITROGEN	THE DIGESTION OF POULTRY FECES UNDER CAGES-ABSTRACT KEYWORDS ODOR AEROBIC-CONDITIONS
100 68 0452	NITROGEN	GROUNDWATER CONTAMINATION KEYWORDS NITROGEN BARNYARD GROUNDWATER CONTAMINATION
100 69 0071	NITROGEN	ENGINEERING ANALYSIS OF CATTLE FEEDLOTS TO REDUCE WATER POLLUTION KEYWORDS RUNOFF PRECI
100 69 0355	NITROGEN	FARM-WASTES KEYWORDS BOD COD HOLLAND AEROBIC-TREATMENT NUTRIENTS NITROGEN OXYGENATION
100 69 0364	NITROGEN	LOSSES OF ENERGY AND NITROGEN ON DRYING POULTRY EXCRETA KEYWORDS FREEZE-DRYING TEMPER
100 69 0679	NITROGEN	NITROGEN LOSSES FROM ALKALINE WATER IMPOUNDMENTS KEYWORDS EUTROPHICATION AMMONIA NITR
100 70 0049	NITROGEN	USE OF SOIL TO TREAT ANAEROBIC LAGOON EFFLUENT RENOVATION AS A FUNCTION OF DEPTH AND AP
100 70 0050	NITROGEN	TREATMENT AND DISPOSAL OF ANIMAL WASTES KEYWORDS LAGOONS NUTRIENTS CONFINEMENT HOLDI
100 70 0367	NITROGEN	NITROGEN AND AMINO ACIDS IN THE FECES OF YOUNG PIGS RECEIVING A PROTEIN-FREE DIET AND D
100 70 0413	NITROGEN	VALUE OF PROCESSED POULTRY WASTE AS A FEED FOR RUMINANTS KEYWORDS WASTE-TREATMENT DIG
100 70 0458	NITROGEN	USE OF SOIL TO TREAT ANAEROBIC LAGOON EFFLUENT DESIGN AND OPERATION OF A FIELD DISPOSA
100 70 1037	NITROGEN	NITROGEN IN AGRICULTURE THE PROBLEMS AND THE EFFECT ON THE ENVIRONMENT KEYWORDS
100 70 1194	NITROGEN	REVIEW OF NATIONAL RESEARCH POLICY ON EUTROPHICATION PROBLEMS KEYWORDS EUTROPHICATION
100 70 1233	NITROGEN	LOSSES OF NITROGEN AND PHOSPHORUS FROM AGRICULTURAL LAND KEYWORDS WATER-POLLUTION-SOURC
100 70 1251	NITROGEN	AIRBORNE AMMONIA EUTROPHIES LAKES KEYWORDS AMMONIA EUTROPHICATION NITROGEN ALGAE WATER-
100 71 0266	NITROGEN	CAGED LAYER PERFORMANCE IN PENS WITH OXIDATION DITCHES AND LIQUID MANURE STORAGE TANKS
100 71 0318	NITROGEN	RUNOFF, SOLID WASTES, AND NITRATE MOVEMENT ON BEEF FEEDLOTS KEYWORDS COD BOD DO SOIL-C
100 71 0589	NITROGEN	SOIL MICROBIOLOGY AND BIOCHEMISTRY KEYWORDS NITROGEN AMMONIA-VOLATILIZATION FEEDLOTS
100 71 1039	NITROGEN	NUTRIENTS IN STREAMS DRAINING WOODLAND AND FARMLAND NEAR COSHOCTON OHIO KEYWORDS
100 71 1197	NITROGEN	NUTRIENT LOSSES FROM AGRICULTURAL LAND KEYWORDS EUTROPHICATION AGRICULTURAL-RUNOFF FERT
100 71 1214	NITROGEN	THE DISPOSAL OF AGRICULTURAL WASTE KEYWORDS WASTE-DISPOSAL FARM-WASTES WATER-POLLUTION
100 72 0746	NITROGEN	RECYCLING SYSTEM FOR POULTRY WASTES KEYWORD NITROGEN LAGOON PUMPING AEROBIC BIOCHEMIC
100 73 1069	NITROGEN	MANURING OF POTATOES ON PEN SILT SOILS IN HOLLAND LINCOLNSHIRE KEYWORDS
100 73 1087	NITROGEN	ENRICHMENT OF THE ATMOSPHERE WITH NITROGEN COMPOUNDS VOLATILIZED FROM A LARGE DAIRY ARE
100 73 1155	NITROGEN	THE FATE OF SOLUBLE MUCIN IN THE GASTRO INTESTINAL TRACT OF SHEEP KEYWORDS
100 73 1162	NITROGEN	PERSISTENCE OF MANURE PHOSPHORUS AVAILABILITY IN CALCAREOUS SOIL KEYWORDS
100 73 1184	NITROGEN	ANIMAL WASTE MANAGEMENT IN HAWAII KEYWORDS FARM-WASTES LIVESTOCK WASTE-DISPOSAL WASTE-T
200 64 0750	NITROGEN	LAGOONING OF LIVESTOCK WASTES IN SOUTH DAKOTA KEYWORD ANAEROBIC AEROBIC POULTRY CONFI
200 64 0759	NITROGEN	STREAM POLLUTION FROM FEEDLOT RUNOFF KEYWORD KANSAS BIOCHEMICAL-OXYGEN-DEMAND CHEMICA
200 66 0115	NITROGEN	MANAGEMENT OF FARM ANIMAL WASTES KEYWORDS ECONOMICS BOD COD SLURRIES DISPOSAL ODOR ST
200 66 0120	NITROGEN	STORMWATER RUNOFF FROM CATTLE FEEDLOTS KEYWORDS STORAGE NITROGEN ORGANIC-WASTE RAINFA
200 66 0155	NITROGEN	PLANT RESPONSE TO MANURE NUTRIENTS AND PROCESSING OF ORGANIC WASTES KEYWORDS LIQUID-W
200 66 0156	NITROGEN	BIOLOGICAL TREATMENT OF ANIMAL WASTES KEYWORDS SWINE COST BOD NITROGEN NITROGEN-BALAN
200 66 1112	NITROGEN	CATTLE FEEDLOT RUNOFF NATURE AND BEHAVIOR KEYWORDS WATER-POLLUTION-SOURCES SURFACE-RUNO
200 68 0724	NITROGEN	GUIDELINES TO LAND REQUIREMENTS FOR DISPOSAL OF LIQUID MANURE KEYWORDS POULTRY CONFIN
200 69 0162	NITROGEN	THEORY AND FUTURE OUTLOOK OF ANIMAL WASTE TREATMENT IN CANADA AND THE UNITED STATES KE
200 69 0165	NITROGEN	AEROBIC DECOMPOSITION OF SOLID WASTES FROM CATTLE FEEDLOTS KEYWORDS MOISTURE-CONTENT
200 69 0170	NITROGEN	THE VALUE OF HYDROLYZED AND DRIED POULTRY WASTE AS A FEED FOR RUMINANT ANIMALS KEYWORD
200 69 0183	NITROGEN	THE EFFECT OF FEED, DESIGN, AND MANAGEMENT ON THE CONTROL OF POLLUTION FROM BEEF CATTLE
200 69 0185	NITROGEN	WASTE DISPOSAL MANAGEMENT KEYWORDS NITROGEN WATER-POLLUTION INCINERATION STORAGE MORT
200 69 0196	NITROGEN	THE INFLUENCE OF VARIOUS FACTORS ON POULTRY LITTER COMPOSITION KEYWORDS NITROGEN CARB
200 69 0199	NITROGEN	RELATIVE ECONOMICS OF ANIMAL WASTE DISPOSAL BY SELECTED WET AND DRY TECHNIQUES KEYWORD
200 69 0200	NITROGEN	THE ECONOMICS OF POULTRY MANURE DISPOSAL KEYWORDS FERTILIZERS NITROGEN PHOSPHORUS POT
200 69 0429	NITROGEN	CONTRIBUTION OF FERTILIZERS TO WATER POLLUTION KEYWORDS EUTROPHICATION EROSION NITROG
200 69 0433	NITROGEN	EFFECT OF AGRICULTURE ON WATER QUALITY KEYWORDS EROSION SEDIMENTATION NUTRIENTS RUNOF
200 69 0521	NITROGEN	WATER-QUALITY PROBLEMS KEYWORDS WATER-POLLUTION NITROGEN PHOSPHORUS NITRATES BASE-FL
200 69 1116	NITROGEN	MANAGING LIVESTOCK WASTES TO CONTROL POLLUTION KEYWORDS POLLUTION-CONTROL ORGANIC-LOADI
200 70 0222	NITROGEN	THE NITROGEN-CYCLE OF A DAIRY FARM KEYWORDS NUTRIENTS FERTILIZATION FOLIAR-APPLICATION
200 70 0720	NITROGEN	PROGRESS REPORT PASTURE FERTILIZATION USING POULTRY LITTER KEYWORDS FARM-WASTE WASTE-
200 71 0608	NITROGEN	RECYCLING OF ANIMAL WASTES KEYWORDS REUSE FERTILIZATION NUTRITION PHOSPHORUS NITROGEN
200 71 0774	NITROGEN	MANAGEMENT OF BARNLOT RUNOFF TO IMPROVE DOWNSTREAM WATER QUALITY KEYWORDS SPRINKLER-I
200 71 0775	NITROGEN	TRANSPORT OF POLLUTANTS FROM SLOPING CATTLE FEEDLOTS AS AFFECTED BY RAINFALL INTENSITY,
200 71 0776	NITROGEN	CHARACTERISTICS OF MANURE ACCUMULATIONS REMOVED FROM OUTDOOR,UNPAVED, BEEF CATTLE FEEDL
200 71 0777	NITROGEN	FEEDLOT MANURE MANAGEMENT IN A DESERT CLIMATE KEYWORDS ODOR DUST NITROGEN LAGOON EVAP
200 71 0778	NITROGEN	LAND DISPOSAL OF CATTLE FEEDLOT WASTES KEYWORDS RUNOFF LAGOON RAINFALL CORN IRRIGATIO
200 71 0782	NITROGEN	MULTISTAGE LAGOON SYSTEMS FOR TREATMENT OF DAIRY FARM WASTE KEYWORDS SPRINKLER-IRRIGAT
200 71 0784	NITROGEN	A FARM SCALE DAIRY WASTE DISPOSAL SYSTEM KEYWORDS CATTLE SPRINKLER-IRRIGATION CONFINE
200 71 0785	NITROGEN	A TOTAL BIOCHEMICAL RECYCLE PROCESS FOR CATTLE WASTES KEYWORDS LIQUID-WASTES PHOSPHAT

200 71 0786	NITROGEN	THE UK RECONCILIATION OF MODERN INTENSIVE LIVESTOCK FARMING WITH A BASICALLY URBAN SOCI
200 71 0794	NITROGEN	AMMONIA DESORPTION FROM CONCENTRATED CHICKEN MANURE SLURRIES KEYWORDS NITROGEN MICROF
200 71 0796	NITROGEN	DIFFERENTIATION OF RUMINANT FROM NON-RUMINANT FECAL SOURCES OF WATER POLLUTION BY USE O
200 71 0798	NITROGEN	THE ROLE OF MICROORGANISMS IN THE MANAGEMENT OF ANIMAL WASTES ON BEEF CATTLE FEEDLOTS
200 71 0805	NITROGEN	HIGH RATE POULTRY MANURE COMPOSTING WITH SAWDUST KEYWORDS AEROBIC-TREATMENT COMPOSTIN
200 71 0808	NITROGEN	WATER HYACINTHS TO FURTHER TREAT ANAEROBIC LAGOON EFFLUENT KEYWORDS AEROBIC-LAGOON OX
200 71 0810	NITROGEN	WATER AND SOIL OXYGEN DEMAND OF LIVESTOCK WASTES KEYWORDS SULFUR CARBON NITROGEN BOD
200 71 1033	NITROGEN	NITROGEN IN INDUSTRY KEYWORDS NITROGEN INDUSTRY FERTILIZERS WATER-POLLUTION AMMONIA FAR
200 72 1012	NITROGEN	REGIONAL LIVESTOCK WASTE MANAGEMENT PROGRAM KEYWORDS RESEARCH-AND-DEVELOPMENT LIVESTOCK
200 73 1062	NITROGEN	CONTINUED RECYCLING OF CATTLE MANURE KEYWORDS CATTLE FARM-WASTES RECYCLING NITROGEN CAL
200 73 1093	NITROGEN	DEHYDRATED POULTRY MANURE AS A CRUDE PROTEIN SUPPLEMENT FOR SHEEP KEYWORDS
200 73 1189	NITROGEN	A FEEDER LOOKS AT ANIMAL WASTE DISPOSAL KEYWORDS FARM-WASTES WASTE-DISPOSAL FEED-LOTS F
300 62 0754	NITROGEN	NOTES ON WATER POLLUTION WASTE WATERS FROM FARMS KEYWORDS FARM-WASTES IRRIGATION BOD
300 69 0005	NITROGEN	SWINE WASTE MANAGEMENT-PROPERTIES OF SWINE WASTES-FACT SHEET KEYWORDS PHYSICAL-CHEMIC
300 69 0632	NITROGEN	QUALITATIVE DETERMINATION OF THE ODOR QUALITY OF CHICKEN MANURE KEYWORDS GAS-CHROMATO
300 69 1180	NITROGEN	CATTLE FEEDLOT POLLUTION STUDY KEYWORDS CATTLE FEED-LOTS FARM-WASTES WASTE-DISPOSAL RUN
300 70 0592	NITROGEN	PLANT NUTRIENTS AND ANIMAL WASTE DISPOSAL KEYWORDS ENVIRONMENTAL-EFFECTS PUBLIC-HEALT
300 70 1059	NITROGEN	NITRATE ACCUMULATION IN KANSAS GROUNDWATER KEYWORDS NITRATES GROUNDWATER FERTILIZATION
300 71 0269	NITROGEN	INFILTRATION RATES AND GROUNDWATER QUALITY BENEATH CATTLE FEEDLOTS, TEXAS HIGH PLAINS
300 71 0624	NITROGEN	FEEDING DEHYDRATED POULTRY WASTE TO DAIRY COWS KEYWORDS CATTLE DRYING AMINO-ACIDS NITR
300 71 0700	NITROGEN	LIVESTOCK WASTE DISPOSAL AND WATER POLLUTION CONTROL KEYWORD FEED-LOTS CATTLE RUNOFF
300 71 0732	NITROGEN	CLOSED SYSTEMS FOR ANIMAL SEWAGE TREATMENT KEYWORD ENVIRONMENTAL-EFFECTS DAIRY-INDUST
300 71 1058	NITROGEN	DEVELOPMENT OF A MATHEMETICAL MODEL TO PREDICT THE ROLE OF SURFACE RUNOFF AND GROUNDWA
300 72 1052	NITROGEN	EFFECT OF ANIMAL WASTES APPLIED TO SOILS ON SURFACE AND GROUNDWATER SYSTEMS KEYWORDS
300 72 1157	NITROGEN	CANADA ANIMAL WASTE MANAGEMENT GUIDE KEYWORDS FARM-WASTES LIVESTOCK PRODUCTION DESIGN M
300 72 1170	NITROGEN	POLLUTION LOADS IN PERCOLATE WATER FROM SURFACE SPREAD SWINE WASTES KEYWORDS
300 72 1260	NITROGEN	NONPOINT RURAL SOURCES OF WATER POLLUTION KEYWORDS WATER POLLUTION RURAL AREAS FERTILIZ
300 73 1009	NITROGEN	STREAM POLLUTION FROM CATTLE FEEDLOT RUNOFF KEYWORDS WATER-POLLUTION CATTLE FARM-WASTES
400 65 0433	NITROGEN	THE DECOMPOSITION OF URIC ACID IN BUILT UP POULTRY LITTER KEYWORDS DECOMPOSING ORGANIC
400 69 1045	NITROGEN	AGRICULTURES CONTRIBUTION TO THE FERTILIZATION OF CANAL LAKE KEYWORDS EUTROPHICATION NU
400 69 1225	NITROGEN	CONSERVING RESOURCES AND MAINTAINING A QUALITY ENVIRONMENT KEYWORDS WATER-RESOURCE-DEV
400 70 0577	NITROGEN	BLOCK DRYING OF CHICKEN MANURE KEYWORDS DRYING POULTRY MOISTURE CONTENT ODOR NITROGEN
400 72 1173	NITROGEN	NEW ODOR CONTROL PRODUCT KEYWORDS ODOR WASTE-DISPOSAL FEED-LOTS LAGOONS OXYGEN NITROGEN
500 70 0388	NITROGEN	CHEMISTRY OF SEDIMENT IN WATER KEYWORDS NITROGEN PHOSPHORUS WATER-POLLUTION CLAYS ORG
500 70 0394	NITROGEN	FERTILIZER-MANAGEMENT FOR POLLUTION-CONTROL KEYWORDS NITROGEN PHOSPHORUS SOIL-EROSION
500 70 0405	NITROGEN	EFFECTS OF AGRICULTURAL-POLLUTION ON EUTROPHICATION KEYWORDS NITROGEN PHOSPHOROUS NITRA
500 70 0407	NITROGEN	EFFECTS OF SURFACE-RUNOFF ON THE FEASIBILITY OF MUNICIPAL ADVANCED WASTE-TREATMENT KEY
600 70 0098	NITROGEN	BEEF CONFINEMENT SYSTEMS - OXIDATION DITCH KEYWORDS COD BOD TS TVS PH DO TEMPERATURE
600 71 0493	NITROGEN	NUTRIENTS IN EFFLUENTS FROM ANIMAL PRODUCTION AREAS KEYWORDS MANAGEMENT COLIFORMS RUN
600 71 0496	NITROGEN	DESORPTION OF AMMONIA FROM ANAEROBIC LAGOONS KEYWORDS FARM-WASTES ANAEROBIC-DIGESTION
600 72 1156	NITROGEN	SEEPAGE LOSSES AND FERTILIZER PRESERVATION IN MANURE STACKING PRACTICE KEYWORDS
600 72 1163	NITROGEN	ACTIVATED SLUDGE AS A SOURCE OF PROTEIN KEYWORDS BACTERIA PROTEINS AMINO-ACIDS NITROGEN
600 72 1177	NITROGEN	DISPOSAL OF BEEF FEEDLOT WASTES ONTO CROPLAND KEYWORDS FARM-WASTES WASTE-DISPOSAL CATTL
700 70 1066	NITROGEN	WATER POLLUTION BY SWINE PRODUCTION OPERATIONS KEYWORDS EFFLUENT WASTE-DISPOSAL HYDROGR
700 70 1109	NITROGEN	AN EVALUATION OF AN ANAEROBIC LAGOON TREATING SWINE WASTES KEYWORDS FARM-WASTES HOGS A
700 72 1048	NITROGEN	SPRINKLER APPLICATION OF ANAEROBICALLY TREATED SWINE WASTES AS LIMITED BY NITROGEN CONC
200 66 0156	NITROGEN-BALANCE	BIOLOGICAL TREATMENT OF ANIMAL WASTES KEYWORDS SWINE COST BOD NITROGEN NITROGEN-BALAN
100 67 0079	NITROGEN-COMPOUNDS	SOURCES OF NITROGEN AND PHOSPHORUS IN WATER SUPPLIES KEYWORDS DISTRIBUTION FERTILIZERS
100 72 1222	NITROGEN-COMPOUNDS	PEPSIN DIGESTIBILITY METHOD FOR ANIMAL PROTEINS KEYWORDS DIGESTION FILTRATION ANALYTICA
200 70 1115	NITROGEN-COMPOUNDS	CONTROL OF NITROGEN FROM ANIMAL WASTE WATERS KEYWORDS FARM-WASTES NITROGEN-COMPOUNDS WA
200 71 0646	NITROGEN-COMPOUNDS	FARM LAND RUNOFF KEYWORDS NITROGEN-COMPOUNDS PHOSPHORUS- COMPOUNDS SOIL-EROSION RUNO
200 71 1099	NITROGEN-COMPOUNDS	SUMMER CONFERENCE OF SOCIETY FOR APPLIED BACTERIOLOGY KEYWORDS MICROORGANISMS WATER-POL
200 71 1252	NITROGEN-COMPOUNDS	NITRATE POLLUTION OF WATER KEYWORDS WATER-POLLUTION-SOURCES GROUNDWATER SURFACE-WATERS
300 70 1036	NITROGEN-COMPOUNDS	AGRICULTURE THE UNSEEN FOE IN THE WAR ON POLLUTION KEYWORDS AGRICULTURE WATER-POLLUTIO
100 66 1080	NITROGEN-CYCLE	NITROGEN COMPOUNDS IN NATURAL WATFR--A REVIEW KEYWORDS NITROGEN WATER FARM-WASTES GROUN
100 70 1037	NITROGEN-CYCLE	NITROGEN IN AGRICULTURE THE PROBLEMS AND THE EFFECT ON THE ENVIRONMENT KEYWORDS
200 70 0325	NITROGEN-CYCLE	RECYCLING AND UTILIZATION OF BIODEGRADABLE-WASTES IN THE SOIL KEYWORDS BIOLOGICAL-SYST
200 71 0838	NITROGEN-CYCLE	NITROGEN TRANSFORMATION DURING AEROBIC DIGESTION AND DENITRIFICATION OF DAIRY CATTLE WA
300 68 1122	NITROGEN-CYCLE	NITROGEN CYCLE IN SURFACE AND SUBSURFACE WATERS KEYWORDS DOMESTIC-ANIMALS WASTES FERTIL
700 71 1120	NITROGEN-CYCLE	SOURCES OF PHOSPHATE AMMONIUM AND NITRATE CONTAMINATION IN SOME CENTRAL NEW JERSEY STR
100 65 1219	NITROGEN-DEPOSITS	NITRATES IN THE ENVIROMENT KEYWORDS NITROGEN ATMOSPHERE BIOSPHERE FERTILIZATION NITROG
200 67 1243	NITROGEN-DRAINAGE	THE IMPACT OF ANIMAL WASTES ON WATER RESOURCES ACTIVITIES KEYWORDS ANIMAL-WASTES WASTES
100 69 0103	NITROGEN-ENRIGHMEN	NITROGEN ENRICHMENT OF SURFACE WATER BY ABSORPTION OF AMMONIA VOLATILIZED FROM CATTLE F
100 65 1219	NITROGEN-FIXATION	NITRATES IN THE ENVIROMENT KEYWORDS NITROGEN ATMOSPHERE BIOSPHERE FERTILIZATION NITROG
100 70 1037	NITROGEN-FIXATION	NITROGEN IN AGRICULTURE THE PROBLEMS AND THE EFFECT ON THE ENVIRONMENT KEYWORDS
200 71 1234	NITROGEN-FIXATION	SOME OBSERVATIONS ON THE LIMNOLOGY OF A POND RECEIVING ANIMAL WASTES KEYWORDS
300 71 1058	NITROGEN-FIXATION	DEVELOPMENT OF A MATHEMETICAL MODEL TO PREDICT THE ROLE OF SURFACE RUNOFF AND GROUNDWA
100 65 1219	NITROGEN-FIXING-BA	NITRATES IN THE ENVIROMENT KEYWORDS NITROGEN ATMOSPHERE BIOSPHERE FERTILIZATION NITROG
100 70 1037	NITROGEN-FIXING-VA	NITROGEN IN AGRICULTURE THE PROBLEMS AND THE EFFECT ON THE ENVIRONMENT KEYWORDS
500 71 1254	NITROGEN-FIXING-BA	ISOLATION OF ANAEROBES KEYWORDS ISOLATION CULTURES SOIL-BACTERIA PROTOZOA FUNGI PHOTOS
100 70 1233	NITROGEN-LOSSES	LOSSES OF NITROGEN AND PHOSPHORUS FROM AGRICULTURAL LAND KEYWORDS WATER-POLLUTION-SOURC
200 69 0174	NITROGEN-POLLUTION	THE NITROGEN PROBLEM IN THE LAND DISPOSAL OF LIQUID MANURE KEYWORDS GROUNDWATER NITRA
200 70 1115	NITROGEN-REMOVAL	CONTROL OF NITROGEN FROM ANIMAL WASTE WATERS KEYWORDS FARM-WASTES NITROGEN-COMPOUNDS WA
100 65 1079	NITROGEN-RETENTION	UTILIZATION OF DIFFERENT LEVELS OF POULTRY LITTER NITROGEN BY SHEEP KEYWORDS
100 73 1088	NITROGEN-RETENTION	OBSERVATIONS ON THE EFFECT OF PROTEIN INTAKE AND STAGE OF GESTATION ON THE PROPORTION O
300 71 1057	NOCOMIS-ASPER	EFFFCTS OF POLLUTION ESPECIALLY FROM FEEDLOTS ON FISHES IN THE UPPER NEOSHO RIVER BASI
300 70 0073	NOISE	STOCKMEN S LIABILITY UNDER THE MISSOURI NUISANCE LAW KEYWORDS ODOR NOISE LAWSUITS DAMA
400 70 0046	NOISE	FARM WASTE DISPOSAL - AMENITY AND GOOD NEIGHBOURLINESS KEYWORDS ODOR WATER-POLLUTION BU
100 73 1087	NONDISTILLABLE-NIT	ENRICHMENT OF THE ATMOSPHERE WITH NITROGEN COMPOUNDS VOLATILIZED FROM A LARGE DAIRY ARE
300 71 1246	NON-STRUCTURAL-ALT	FEEDLOT WASTE MANAGEMENT KEYWORDS WATER-POLLUTION-CONTROL CONFINEMENT-PENS CATTLE POLLU
200 71 0601	NORTH	PROPOSED ANIMAL WASTE POLLUTION CONTROL LEGISLATION IN NORTH CAROLINA KEYWORDS REGULA
700 70 1066	NORTH-CAROLINA	WATER POLLUTION BY SWINE PRODUCTION OPERATIONS KEYWORDS EFFLUENT WASTE-DISPOSAL HYDROGR
200 69 0557	NORTH-DAKOTA	STATUS OF NORTH DAKOTA S PROGRAM TO CONTROL POLLUTION FROM ANIMAL FEEDLOTS KEYWORDS
200 71 0641	NORTH-DAKOTA	BACTERIAL COUNTS OF A SECTION OF THE RED RIVER-SUMMER 1970 KEYWORDS COLIFORMS BACTERI
200 72 1014	NORTH-DAKOTA	APPLICATION UTILIZATION AND DISPOSAL OF LIVESTOCK WASTE KEYWORDS WASTE-DISPOSAL WASTE-T
300 69 1060	NORTH-DAKOTA	FOULING OF WATERS A MISDEMEANOR KEYWORDS NORTH-DAKOTA SOURCES WATER-POLLUTION-CONTROL
300 69 1203	NORTH-DAKOTA	FOULING OF WATERS A MISDEMEANOR KEYWORDS NORTH-DAKOTA SOURCES WATER-POLLUTION
300 71 1057	NOTORUS-PLACIDUS	EFFECTS OF POLLUTION ESPECIALLY FROM FEEDLOTS ON FISHES IN THE UPPER NEOSHO RIVER BASI
300 71 1057	NOTROPIS-CAMURUS	EFFECTS OF POLLUTION ESPECIALLY FROM FEEDLOTS ON FISHES IN THE UPPER NEOSHO RIVER BASI
300 71 1057	NOTROPIS-LUTRENSIS	EFFECTS OF POLLUTION ESPECIALLY FROM FEEDLOTS ON FISHES IN THE UPPER NEOSHO RIVER BASI
300 71 1057	NOTROPIS-RUBELLUS	EFFECTS OF POLLUTION ESPECIALLY FROM FEEDLOTS ON FISHES IN THE UPPER NEOSHO RIVER BASI
300 71 1057	NOTURUS-NOCTURNUS	EFFECTS OF POLLUTION ESPECIALLY FROM FEEDLOTS ON FISHES IN THE UPPER NEOSHO RIVER BASI
200 70 0234	NUISANCE	FARM WASTES KEYWORDS DISPOSAL UNITED-KINGDOM SLURRIES BOD COD DO ODOR COSTS EQUIPMENT
200 70 0239	NUISANCE	FARM WASTES PUBLIC HEALTH AND NUISANCE PROBLEMS OFF THE FARM KEYWORDS ODOR LEGISLATI
400 70 0068	NUISANCE	POSSIBLE DEFENSES AGAINST NUISANCE COMPLAINTS KEYWORDS LEGAL-ASPECTS POULTRY NUISANCE
500 70 0408	NUISANCE	LEGAL-ASPECTS KEYWORDS WATER-POLLUTION PESTICIDES SILTING FERTILIZERS POINT-SOURCES N
400 70 0046	NUISANCES	FARM WASTE DISPOSAL - AMENITY AND GOOD NEIGHBOURLINESS KEYWORDS ODOR WATER-POLLUTION BU
200 71 0440	NUISANCE-LAW	LEGAL-ASPECTS PERTAINING TO ENVIRONMENTAL REGULATIONS IN PORK-PRODUCTION KEYWORDS NUI
300 46 1208	NUISANCE-WATER-LAW	GREEN V MCCLOUD ACTION TO ENJOIN SEWAGE FLOW KEYWORDS KENTUCKY DOMESTIC-WASTES WATER-PO
300 70 1000	NURSURY-BUILDING	EQUIPMENT AND FACILITIES FOR MODERN METHODS OF SWINE MANURE DISPOSAL KEYWORDS

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100 71 1038  NUTIRENTS              CONCENTRATIONS OF POLLUTANTS IN AGRICULTURAL RUNOFF KEYWORDS LAKES WATER-QUALITY TEXAS
100 71 0751  NUTRIENT               ANIMAL WASTE VALUE-NUTRIENT RECOVERY AND UTILIZATION  KEYWORDS  POULTRY SWINE CATTLE PA
100 72 0746  NUTRIENT               RECYCLING SYSTEM FOR POULTRY WASTES  KEYWORD  NITROGEN LAGOON PUMPING AEROBIC BIOCHEMIC
200 69 0427  NUTRIENT               MANAGEMENT OF ANIMAL FEEDLOT WASTES - LAND SPREADING AS A DISPOSAL PROCESS KEYWORDS  NU
200 70 0498  NUTRIENT               WATER POLLUTION CONTROL IN CATTLE FEEDLOTS  KEYWORD  RUNOFF ECONOMICS FERTILIZER NUTRIE
200 71 0857  NUTRIENT               NITROGEN REMOVAL FROM SEWAGE WATERS BY PLANTS AND SOIL  KEYWORD  FARM-WASTES SOIL-FILTE
300 71 0628  NUTRIENT               THE METABOLIZEABLE ENERGY VALUE OF DRIED POULTRY WASTE  KEYWORDS  NUTRIENT DEHYDRATION
300 71 0629  NUTRIENT               THE EFFECTS OF CONTINUALLY RECYCLING DEHYDRATED POULTRY WASTES  DPW  ON THE PERFORMANCE
100 65 0263  NUTRIENTS              REMOVAL OF PLANT NUTRIENTS BY MEANS OF AEROBIC STABILIZATION OF SLUDGE  KEYWORDS WASTE
100 68 0090  NUTRIENTS              WILSCHWITZ RUNOFF SAMPLER  KEYWORDS  NUTRIENTS WATER-LEVEL  PREDICTION-EQUATIONS WEIRS
100 68 0370  NUTRIENTS              EFFECT OF SOIL TEMPERATURE ON THE AVAILABILITY OF PHOSPHOROUS IN ANIMAL MANURES  KEYWOR
100 68 1121  NUTRIENTS              WATER POLLUTION FROM LAND RUNOFF KEYWORDS RUNOFF WATER-POLLUTION INFILTRATION SEDIMENTS
100 69 0259  NUTRIENTS              ANIMAL-WASTES - A NATIONAL PROBLEM  KEYWORDS POLLUTION BOD  COD NUTRIENTS ANAEROBIC-DIG
100 69 0355  NUTRIENTS              FARM-WASTES  KEYWORDS BOD COD HOLLAND AEROBIC-TREATMENT NUTRIENTS NITROGEN OXYGENATION
100 70 0050  NUTRIENTS              TREATMENT AND DISPOSAL OF ANIMAL WASTES  KEYWORDS  LAGOONS  NUTRIENTS CONFINEMENT HOLDI
100 70 0082  NUTRIENTS              HOUSE FLY PUPAE AS FOOD FOR POULTRY  KEYWORDS  FEEDS NUTRIENTS MUSCA-DOMESTICA
100 70 0112  NUTRIENTS              CURRENT TRENDS IN FARM WASTE DISPOSAL  KEYWORDS  NUTRIENTS EXCRETION UK ODOR POPULATION
100 70 0372  NUTRIENTS              DRAINAGE AND POLLUTION FROM BEEF CATTLE-FEEDLOTS  KEYWORDS  RUNOFF SURFACE-DRAINAGE GRO
100 70 0510  NUTRIENTS              CATTLE, SWINE AND CHICKEN MANURE CHALLENGES WASTE DISPOSAL METHODS  KEYWORDS  COSTS FER
100 70 1230  NUTRIENTS              LAGOONS AND OXIDATION PONDS LITERATURE REVIEW KEYWORDS WASTE-WATER-TREATMENT LAGOONS PO
100 71 0453  NUTRIENTS              PLANT NUTRIENTS AND WATER QUALITY KEYWORDS  NUTRIENTS WATER-QUALITY
100 71 0721  NUTRIENTS              HOW ENVIRONMENTAL PROBLEMS AFFECT FARM EQUIPMENT DESIGN  KEYWORD  FERTILIZER ODOR RUNOF
100 71 0688  NUTRIENTS              CHARACTERIZATION OF WASTE TREATMENT PROPERTIES OF PIG MANURE  KEYWORD  FEED BIOCHEMICAL
100 71 1039  NUTRIENTS              NUTRIENTS IN STREAMS DRAINING WOODLAND AND FARMLAND NEAR COSHOCTON OHIO KEYWORDS
100 71 1212  NUTRIENTS              EFFECTS OF MULTIPLE USE ON WATER QUALITY OF HIGH MOUNTAIN WATERSHEDS BACTERIOLOGICAL IN
100 71 1228  NUTRIENTS              ALTERNATIVES FOR THE TREATMENT AND DISPOSAL OF ANIMAL WASTES  KEYWORDS FARM-WASTES DISP
100 71 1236  NUTRIENTS              MIGRATION OF POLLUTANTS IN A GLACIAL OUTWASH ENVIRONMENT KEYWORDS PATH-OF-POLLUTANTS GL
100 72 1193  NUTRIENTS              CHARACTERISTICS OF MILKING CENTER WASTE EFFLUENT FROM NEW YORK STATE DAIRY FARMS KEYWOR
100 73 1069  NUTRIENTS              MANURING OF POTATOES ON PEA SILT SOILS IN HOLLAND LINCOLNSHIRE KEYWORDS
100 70 1237  NUTRIENTS              POLLUTION POTENTIAL OF SALMONID FISH HATCHERIES KEYWORDS SOURCES FISH-HATCHERIES SALMON
200 66 0146  NUTRIENTS              UTILIZATION OF ANIMAL WASTE AS FEED FOR RUMINANTS  KEYWORDS CATTLE SILAGE NUTRIENTS MAN
200 66 0148  NUTRIENTS              ROLE OF THE RENDERER IN THE USE AND DISPOSAL ANIMAL WASTES  KEYWORDS  POULTRY CATTLE EC
200 66 0149  NUTRIENTS              EVALUATING ADAPTABILITY OF PASTURE GRASSES TO HYDROPONIC CULTURE AND THEIR ABILITY TO A
200 66 0149  NUTRIENTS              EVALUATING ADAPTABILITY OF PASTURE GRASSES TO HYDROPONIC CULTURE AND THEIR ABILITY TO A
200 66 0151  NUTRIENTS              ECONOMIC EVALUATION OF LIQUID-MANURE DISPOSAL FOR CONFINEMENT FINISHING OF HOGS  KEYWOR
200 66 0152  NUTRIENTS              ECONOMICS OF LIQUID-MANURE DISPOSAL FROM CONFINED LIVESTOCK KEYWORDS  COD BOD COST NUTR
200 69 0423  NUTRIENTS              2 ND COMPENDIUM OF ANIMAL WASTE MANAGEMENT KEYWORDS  RAINFALL-RUNOFF EQUIPMENT DESIGN-D
200 69 0428  NUTRIENTS              DESIGN FOR FEEDLOT WASTE MANAGEMENT - HISTORY AND CHARACTERISTICS  KEYWORDS  RAINFALL-R
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200 66 0144   POULTRY        TREATMENT OF DUCK WASTES AND THEIR EFFECTS ON WATER QUALITY KEYWORDS  COLIFORMS BOD POU
200 66 0145   POULTRY        VALUE OF BROILER LITTER AS FEED FOR RUMINANTS  KEYWORDS SHEEP CATTLE FEEDS NUTRITIVE-VA
200 66 0147   POULTRY        COPROPHAGY AND USE OF ANIMAL WASTE IN LIVESTOCK FEEDS  KEYWORDS  POULTRY CATTLE CATFISH
200 66 0148   POULTRY        ROLE OF THE RENDERER IN THE USE AND DISPOSAL ANIMAL WASTES  KEYWORDS  POULTRY CATTLE EC
200 68 0724   POULTRY        GUIDELINES TO LAND REQUIREMENTS FOR DISPOSAL OF LIQUID MANURE  KEYWORDS  POULTRY CONFIN
200 68 1186   POULTRY        TECHNICAL AND LEGAL CONTROLS FOR THE DISPOSAL OF ANIMAL WASTES KEYWORDS
200 69 0163   POULTRY        DESIGN PARAMETERS FOR THE STABILIZATION OF HIGHLY ORGANIC MANURE SLURRIES BY AERATION
200 69 0172   POULTRY        SPECIFICATIONS FOR EQUIPMENT FOR LIQUID MANURE DISPOSAL BY THE PLOW-FURROW-COVER METHOD
200 69 0173   POULTRY        USE OF POULTRY MANURE FOR CORRECTION OF ZN AND FE DEFICIENCIES IN PLANTS  KEYWORDS  FER
200 69 0179   POULTRY        CHANGES IN COMPOSITION OF CONTINUOUSLY AERATED POULTRY MANURE WITH SPECIAL REFERENCE TO
200 69 0186   POULTRY        MANURE CONSERVATION  KEYWORDS  POULTRY FERTILIZER POTASH AIR-CONDITIONING GROSS-PROFIT
200 69 0189   POULTRY        MEASUREMENT OF THE ODOR STRENGTH OF ANIMAL MANURES  KEYWORDS POULTRY ODOR-STRENGTH VAPO
200 69 0192   POULTRY        POULTRY HOUSE DUST, ODOR AND THEIR MECHANICAL REMOVAL  KEYWORDS  FILTERS FOAM-PAD-FILTE
200 69 0197   POULTRY        REMOVAL OF WATER FROM ANIMAL MANURES  KEYWORDS  POULTRY ODOR MOISTURE-CONTENT WEIGHT VO
200 69 0200   POULTRY        THE ECONOMICS OF POULTRY MANURE DISPOSAL  KEYWORDS  FERTILIZERS NITROGEN PHOSPHORUS POT
200 69 0203   POULTRY        WHO SHOULD REGULATE POULTRY CONFLICT PROBLEMS KEYWORDS TECHNOLOGY ODOR GOVT  COMMUNICAT
200 69 0516   POULTRY        PROCEEDINGS OF FARM ANIMAL WASTE AND BY-PRODUCT MANAGEMENT  CONFERENCE  KEYWORDS  FARM-
200 70 0215   POULTRY        MOVEMENTS OF NUTRIENTS FROM POULTRY MANURE IN SOIL  KEYWORDS SOIL-WATER LYSIMETER PLOW-
200 70 0243   POULTRY        MINIMIZING POULTRY WASTE PROBLEMS  KEYWORDS  COSTS DISPOSAL ODOR BOD UK FERTILIZERS SLU
200 70 0321   POULTRY        WASTE-DISPOSAL AND POLLUTION, POULTRY-PROCESSING  KEYWORDS  RENDERING-PLANT ODORS SEWAG
200 70 0323   POULTRY        AGRICULTURE-WASTE RESEARCH-NEEDS  KEYWORDS  POULTRY ODOR LIQUID-HANDLING SHUD MOISTURE-
200 70 0670   POULTRY        ALTERNATIVES FOR THE TREATMENT AND DISPOSAL OF ANIMAL WASTES  KEYWORDS  FARM-WASTES CON
200 70 0715   POULTRY        OVERALL PROBLEMS AND AN APPROACH TO DISPOSAL OF ANIMAL WASTE KEYWORDS  DEHYDRATION FORC
200 70 0716   POULTRY        BIODEGRADATION OF POULTRY MANURE FROM CAGED LAYERS  KEYWORDS  ODOR POULTRY DRYING LARVA
200 70 0717   POULTRY        PROCESSING PLANT SANITATION AND ITS RELATIONSHIP TO WASTE MANAGEMENT  KEYWORDS  BOD SEW
200 70 0718   POULTRY        WATER UTILIZATION IN PROCESSING PLANTS  KEYWORDS  BOD POULTRY BACTERIA INDUSTRIAL-WASTE
200 70 0719   POULTRY        FEEDING PROBLEMS ARISING FROM THE USE OF POULTRY LITTER ON PASTURES  KEYWORDS  FESCUE P
200 70 0720   POULTRY        PROGRESS REPORT  PASTURE FERTILIZATION USING POULTRY LITTER  KEYWORDS FARM-WASTE WASTE-
200 71 0606   POULTRY        POULTRY WASTE MANAGEMENT  KEYWORDS  EUTROPHICATION ODORS DRYING FIELD-SPREADING POULTRY
200 71 0617   POULTRY        THE ROLE OF EXTENSION IN POLLUTION ABATEMENT IN VIRGINIA  KEYWORDS  POULTRY ADMINISTRAT
200 71 0661   POULTRY        ODORS AND THEIR CONTROL  KEYWORDS  POULTRY CHEMICAL TREATMENT AIR-CIRCULATION DRYING SO
200 71 0762   POULTRY        LIVESTOCK WASTE MANAGEMENT AND POLLUTION ABATEMENT  KEYWORDS  ODORS ECONOMICS DRYING RU
200 71 0768   POULTRY        SYSTEMS FOR THE DEHYDRATION OF LIVESTOCK WASTES  A TECHNICAL AND ECONOMICAL REVIEW  KEY
200 71 0783   POULTRY        SOLVING THE POULTRY MANURE PROBLEM ECONOMICALLY THROUGH DEHYDRATION  KEYWORDS  ODOR DRY
200 71 0786   POULTRY        THE UK RECONCILIATION OF MODERN INTENSIVE LIVESTOCK FARMING WITH A BASICALLY URBAN SOCI
200 71 0788   POULTRY        LITIGATION EXPERIENCES OF FIVE LIVESTOCK AND POULTRY PRODUCERS  KEYWORDS  ODORS LEGAL-A
200 71 0793   POULTRY        CONTROL OF ODORS FROM POULTRY HOUSES  KEYWORDS  ODORS DUST  POULTRY FILTERING-SYSTEM AM
200 71 0794   POULTRY        AMMONIA DESORPTION FROM CONCENTRATED CHICKEN MANURE SLURRIES  KEYWORDS  NITROGEN MICROF
200 71 0797   POULTRY        GROWTH KINETICS OF RUMEN BACTERIA IN SOLUTIONS OF POULTRY EXCRETA  KEYWORDS  FEED MICRO
200 71 0805   POULTRY        HIGH RATE POULTRY MANURE COMPOSTING WITH SAWDUST  KEYWORDS  AEROBIC-TREATMENT COMPOSTIN
200 71 0814   POULTRY        PYROLYSIS OF LIVESTOCK WASTES  KEYWORDS  CHEMICAL-TREATMENT ANAEROBIC CHEMICAL-ANALYSIS
200 71 0815   POULTRY        DRYING POULTRY WASTE  KEYWORDS  ODOR DRYING PROTEIN POTASSIUM PHOSPHORUS POULTRY
200 71 0817   POULTRY        MARKETING CONVERTED POULTRY MANURE  KEYWORDS  FERTILIZERS NUTRIENTS POULTRY MARKET-VALU
200 71 0821   POULTRY        AN OXIDATION DITCH FOR THE HANDLING AND TREATMENT OF POULTRY WASTES KEYWORDS FARM-WASTE
200 71 0824   POULTRY        AEROBIC TREATMENT OF LIQUID AND SOLID POULTRY MANURE  KEYWORDS  BIODEGRADATION NITRIFIC
200 71 0831   POULTRY        EFFECT OF RATE OF POULTRY MANURE APPLICATION ON SELECTED SOIL CHEMICAL PROPERTIES  KEYW
200 71 0835   POULTRY        AEROBIC STORAGE OF POULTRY MANURE  KEYWORD  AERATION AEROBIC-CONDITIONS WASTE-ASSIMILAT
200 71 0842   POULTRY        THE USE OF OXIDATION PONDS FOR POULTRY PROCESSING WASTE DISPOSAL  KEYWORD  INDUSTRIAL-W
200 71 0846   POULTRY        NUTRITIVE VALUE OF CHICKEN MANURE FOR CATTLE KEYWORDS FARM-WASTES RECYCLING CATTLE POUL
200 71 0849   POULTRY        DRIED ANIMAL WASTE AS A PROTEIN SUPPLEMENT FOR RUMINANTS  KEYWORD  RECYCLING POULTRY NU
200 71 0860   POULTRY        DEWATERING POULTRY MANURE BY CENTRIFUGATION  KEYWORD  CENTRIFUGATION DEWATERING POULTRY
300    1105   POULTRY        RULE AND REGULATION FOR THE REGISTRATION OF FEEDLOTS KEYWORDS NEBRASKA WATER-POLLUTION-
300 46 1208   POULTRY        GREEN V MCCLOUD ACTION TO ENJOIN SEWAGE FLOW KEYWORDS KENTUCKY DOMESTIC-WASTES WATER-PO
300 69 0631   POULTRY        ODOURS, GASES, AND PARTICULATE MATTER FROM HIGH DENSITY POULTRY MANAGEMENT SYSTEMS AS TH
300 69 0634   POULTRY        ANALYSIS OF GASES ENCOUNTERED IN A COMMERCIAL POULTRY HOUSE KEYWORDS  ORGANIC-COMPOUNDS
300 69 0637   POULTRY        SOIL FILTRATION TO REMOVE ODORS  KEYWORDS  POULTRY  ORGANIC-COMPOUNDS AMMONIA HYDROGEN-
300 69 0638   POULTRY        ODOR CONTROLS BY CHEMICAL TREATMENT  KEYWORDS  POULTRY AMMONIA-HYDROGEN-SULFIDE CARBON-
300 69 1061   POULTRY        RULES FOR CONFINED FEEDING OPERATIONS WASTE WATER DISPOSAL  KEYWORDS IOWA FARM-WASTES L
300 70 0204   POULTRY        POULTRY POLLUTION  PROBLEMS AND SOLUTIONS  KEYWORDS  EGGS DEHYDRATION FEED DIET ODOR CO
300 70 0206   POULTRY        POULTRY MANURE HANDLING BY INDOOR SEPTIC-TANKS  KEYWORDS SLUDGE DIGESTION VENTILATION A
300 70 0208   POULTRY        DRYING ANIMAL WASTE  KEYWORDS POULTRY CATTLE HOGS MOISTURE-CONTENT NUTRIENTS DENSITY CO
300 70 0210   POULTRY        THE RESULT OF FEEDING DRIED-POULTRY-WASTE TO LAYING HENS ON EGG-PRODUCTION AND FEED-CON
300 70 0213   POULTRY        ACCEPTABILITY AND DIGESTIBILITY OF POULTRY AND DAIRY-WASTES BY SHEEP  KEYWORDS  ANIMAL-
300 70 0384   POULTRY        THE ECONOMICS OF CLEAN WATER  VOLUME TWO  ANIMAL WASTES PROFILE KEYWORDS COSTS WATER-PO
300 70 1247   POULTRY        DISPOSAL OF INDUSTRIAL WASTES KEYWORDS OREGON INDUSTRIAL-WASTES WASTE-DISPOSAL POLLUTIO
300 70 1248   POULTRY        LIVESTOCK INDUSTRIES IN TEXAS AS RELATED TO WATER QUALITY REPORT NUMBER ONE KEYWORDS
300 71 0671   POULTRY        REMOVAL OF WATER FROM ANIMAL MANURES, PART II  EFFECTS OF VELOCITY ON AIR DRYING  KEYWO
300  1 0412   POULTRY        POULTRY
300 71 0477   POULTRY        BIOLOGICAL CONVERSION OF ANIMAL WASTES TO NUTRIENTS KEYWORDS POULTRY FLY-PUPAE NUTRIENT
300 71 0515   POULTRY        FECAL RESIDUES FROM LARVICIDES--POULTRY AND CATTLE  KEYWORDS PATHOGENIC-BACTERIA BORON
300 71 0621   POULTRY        POULTRY POLLUTION  RESEARCH RESULTS  KEYWORDS  ODOR NUTRIENTS DIET AIR-VENTILATION FEED
300 71 0623   POULTRY        ECONOMICS OF DRIED POULTRY WASTE  DPW  AS A FEED INGREDIENT OR A FERTILIZER  KEYWORDS
300 71 0626   POULTRY        DRYING OF POULTRY MANURE IN A CAGE-LAYER HOUSE  KEYWORDS ODOR ENVIRONMENT AIR-VENTILATI
300 71 0628   POULTRY        THE METABOLIZEABLE ENERGY VALUE OF DRIED POULTRY WASTE  KEYWORDS  NUTRIENT DEHYDRATION
300 71 0629   POULTRY        THE EFFECTS OF CONTINUALLY RECYCLING DEHYDRATED POULTRY WASTES  DPW  ON THE PERFORMANCE
300 71 0630   POULTRY        A COMPILATION OF SOME SAMPLES OF DRIED POULTRY WASTE ANALYZED BY DR  E  J  BENNE  KEYWO
300 71 0673   POULTRY        OLFACTORY MEASUREMENT OF ANIMAL MANURE ODORS  KEYWORDS DRYING POULTRY AIR-DRYING-MANURE
300 71 0674   POULTRY        CONTROL OF ODORS THROUGH MANURE MANAGEMENT  KEYWORDS  DRYING POULTRY AIR-DRYING-MANURE
300 71 0677   POULTRY        THE POLLUTION POTENTIAL OF THE CONFINED LIVESTOCK FEEDING INDUSTRY KEYWORDS FARM-WASTES
300 71 1098   POULTRY        BIBLIOGRAPHY OF PRODUCTS DERIVED FROM AQUATIC ORGANISMS KEYWORDS AQUATIC-PLANTS FISH PO
300 71 1126   POULTRY        SAVANNAH RIVER ECOLOGY LABORATORY ANNUAL REPORT 1971 KEYWORDS BORON NUTRIENT-REQUIREMEN
300 72 1092   POULTRY        EFFECT OF ANIMAL WASTES APPLIED TO SOILS ON SURFACE AND GROUNDWATER SYSTEMS KEYWORDS
300 72 1162   POULTRY        BACTERIOLOGICAL PROCEDURES FOR ANALYZING WET AND DRIED POULTRY FECES KEYWORDS
300 72 1264   POULTRY        PRINCIPLES OF FEEDLOT ODOR CONTROL KEYWORDS AIR-POLLUTION FEED-LOTS FARM-WASTES AEROBIC
400 65 0356   POULTRY        FURROW MANURE-DISPOSAL  KEYWORDS  POULTRY APPLICATION-RATES PLOW-FURROW-COVER DISPOSAL
400 66 0088   POULTRY        POULTRY-MANURE DISPOSAL - IS THERE A PROBLEM  KEYWORDS COSTS NUTRIENTS VALUE FERTILIZER
400 68 0449   POULTRY        WASTES FROM THE POULTRY INDUSTRY  KEYWORDS  ENGLAND POULTRY
400 69 0419   POULTRY        DIGESTION OF POULTRY MANURE BY DIPTERA  KEYWORDS  WASTE TREATMENT WASTE DISPOSAL FARM W
400 70 0022   POULTRY        SIMPLE SYSTEM FOR AERATING MANURE LAGOONS KEYWORDS POULTRY AEROBIC-TREATMENT ODOR SPRAY
400 70 0068   POULTRY        POSSIBLE DEFENSES AGAINST NUISANCE COMPLAINTS  KEYWORDS  LEGAL-ASPECTS POULTRY NUISANCE
400 70 0091   POULTRY        MOISTURE INCREASES MANURE ODORS  KEYWORDS  POULTRY AMMONIA  HYDROGEN-SULFIDE CHROMATOGR
400 70 0109   POULTRY        SOME CAUSES OF WET POULTRY MANURE  KEYWORDS  MOISTURE-CONTENT WATER-CONSUMPTION STRAINS
400 70 0111   POULTRY        UNDER-CAGE MANURE DRYING SYSTEM SOLVES ODOR PROBLEMS  KEYWORDS  POULTRY COSTS ECONOMICS
400 70 0308   POULTRY        DEEP PIT SLAT-FLOOR BREEDING HOUSE  KEYWORDS  POULTRY FARM-WASTES SLOTTED-FLOOR VENTILA
400 70 0415   POULTRY        TURNING WASTES INTO PROFITS  KEYWORDS  WASTE-TREATMENT POULTRY DRYING ODOR-CONTROL WAST
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400 70 0577	POULTRY	BLOCK DRYING OF CHICKEN MANURE KEYWORDS DRYING POULTRY MOISTURE CONTENT ODOR NITROGEN
400 71 0293	POULTRY	SODIUM EGG-SHELLS EFF-QUALITY EGG-PRODUCTION ALBUMEN SOUTHERN WORKERS REPORT RESEARCH K
400 71 0294	POULTRY	MANURE MITES IN INTEGRATED FLY CONTROL KEYWORDS POULTRY CALIFORNIA FLY-CONTROL
400 71 0295	POULTRY	OXIDATION DITCH IN CAGE LAYER HOUSE KEYWORDS POULTRY BOD N-IRELAND ODOR OXIDATION-DI
400 71 0297	POULTRY	BROODER-GROW CAGES OVER DEEP PIT KEYWORDS POULTRY FARM-WASTES VENTILATION PIT STORAGE
400 71 0304	POULTRY	CONTROL OF POULTRY HOUSE EXHAUST ODORS KEYWORDS FILTERS DUST WATER-SPRAY CONTROL POUL
400 71 0327	POULTRY	RECYCLED POULTRY NUTRIENTS KEYWORDS FARM-WASTES POULTRY WASTE-DISPOSAL DRIED-POULTRY
400 71 0329	POULTRY	DISPOSAL OF HATCHERY WASTES KEYWORDS POULTRY INCINERATION WASTE TREATMENT DISPOSAL HA
400 71 0349	POULTRY	MAXI-MIXING FOR MANURE DISPOSAL KEYWORDS POULTRY COMPOSTING MIXING DISPOSAL
400 71 0350	POULTRY	SCHEDULE MANURE REMOVAL TO AVOID FLY BREEDING KEYWORDS CALIFORNIA POULTRY [illegible] FLY
400 71 0463	POULTRY	CHEMICAL COMPOSITION OF POULTRY MANURE KEYWORDS CHEMICAL POULTRY CHARACTERISTICS
400 71 0465	POULTRY	FEED ADDITIVE RESIDUES IN POULTRY MANURE KEYWORDS ADDITIVE-RESIDUES POULTRY
400 71 0575	POULTRY	POULTRY WASTE HANDLING SYSTEMS KEYWORDS POULTRY HANDLING-SYSTEMS
400 72 1130	POULTRY	THE OPCCO DRYER KEYWORDS RECYCLING DRYING FERTILIZERS FARM-WASTES WASTE-TREATMENT
400 73 1073	POULTRY	NITRATE CONTENT OF PERCULATES FROM MANURED LYSIMETERS KEYWORDS NITRATES FARM-WASTES LYS
500 [illegible] 1254	POULTRY	ISOLATION OF ANAEROBES KEYWORDS ISOLATION CULTURES SOIL-BACTERIA PROTOZOA FUNGI PHOTOS
600 68 0471	POULTRY	ACCELERATION OF NATURAL DRYING OF POULTRY MANURE THROUGH MECHANICAL AGITATION KEYWORDS
600 72 1031	POULTRY	ELECTRIC IN-HOUSE DRYING OF POULTRY WASTE KEYWORDS POULTRY ODOR NUTRIENTS RECYCLING FAR
600 72 1076	POULTRY	HIGH-TEMPERATURE HIGH-PRESSURE EXTRUSION OF CHICKEN EXCRETA KEYWORDS FARM-WASTES POULTR
700 70 1046	POULTRY	AN ECONOMIC ANALYSIS OF POULTRY PROCESSING WASTEWATER IN DELAWARE AND APPROPRIATE MUNIC
100 69 0374	POULTRY-DROPPINGS	ARTHROPOD-PREDATORS OF IMMATURE DIPTERA DEVELOPING IN POULTRY-DROPPINGS IN NORTHERN CAL
100 69 0373	POULTRY-DROPPINGS	ARTHROPOD-PREDATORS OF IMMATURE DIPTERA DEVELOPING IN POULTRY-DROPPINGS IN NORTHERN CAL
300 69 0636	POULTRY-DUST	PARTICULATE MATTER KEYWORDS CIRCULATION GAS-CHROMATOGRAPHYFILTER-PADS POULTRY-DUST OD
100 69 0363	POULTRY-HOUSES	ODOR-TRANSPORT BY PARTICULATE-MATTER IN HIGH DENSITY POULTRY-HOUSES KEYWORDS GAS-CHROM
100 69 0360	POULTRY-LAGOON	THE BACTERIAL-POPULATION OF AN INDOOR POULTRY-LAGOON KEYWORDS E-COLI BOD MICROORGANISM
100 65 1079	POULTRY-LITTER	UTILIZATION OF DIFFERENT LEVELS OF POULTRY LITTER NITROGEN BY SHEEP KEYWORDS
100 68 0502	POULTRY-LITTER	MANURE-PRODUCTION BY BROILERS KEYWORDS POULTRY-LITTER MOISTURE-CONTENT CRUDE-PROTEIN
100 69 0081	POULTRY-LITTER	DISTRIBUTION OF ARSENIC FROM POULTRY-LITTER IN BROILER-CHICKENS, SOIL, AND CROPS KEYWO
100 69 0376	POULTRY-LITTER	EVALUATION OF SEVERAL METHODS OF ISOLATING SALMONELLA FROM POULTRY-LITTER AND ANIMAL-F
100 70 0110	POULTRY-LITTER	ISOLATION OF SALMONELLAE FROM RENDERED BY-PRODUCTS AND POULTRY LITTER CULTURED IN ENRIC
100 71 0476	POULTRY-LITTER	THE MICROFLORA OF SOUTHERN OHIO POULTRY LITTER KEYWORDS FUNGUS PH BACTERIA MOLD POULTR
100 71 0572	POULTRY-LITTER	AN ASSESSMENT OF SOME PUBLIC HEALTH PROBLEMS RESULTING FROM FEEDING POULTRY LITTER TO A
200 70 0217	POULTRY-LITTER	POLLUTION FACTORS ASSOCIATED WITH EXCESSIVE POULTRY-LITTER MANURE APPLICATION IN ARKA
200 71 0609	POULTRY-LITTER	REGULATORY ASPECTS OF RECYCLED LIVESTOCK AND POULTRY WASTES KEYWORDS REUSE REGULATION
400 65 0439	POULTRY-LITTER	THE DECOMPOSITION OF URIC ACID IN BUILT UP POULTRY LITTER KEYWORDS DECOMPOSING ORGANIC
400 65 0485	POULTRY-LITTER	POULTRY LITTER AS CATTLE FEED KEYWORDS LEGAL-ASPECTS HAZARDS BLOAT EFFICIENCIES RATE-
100 64 0333	POULTRY-MANURE	AEROBIC-DIGESTION, COMPOSTING OF POULTRY-MANURE KEYWORDS AERATION WINDROW-METHOD PRE
100 70 0691	POULTRY-MANURE	THE EFFECT OF HUMIDITY AND FLOORING TYPE ON THE MOISTURE CONTENT OF BROILER EXCREMENTS
200 66 0153	POULTRY-MANURE	POULTRY MANURE MARKETING KEYWORDS FERTILIZER BAGGING PROCESSING TECHNIQUES VALUE ANAL
300 72 1052	POULTRY-MANURE	EFFECT OF ANIMAL WASTES APPLIED TO SOILS ON SURFACE AND GROUNDWATER SYSTEMS KEYWORDS
400 70 0029	POULTRY-MANURE	DRIED POULTRY MANURE AS CATTLE FEED KEYWORDS DRYING NUTRITIONAL-VALUE
100 67 0501	POULTRY-MANURES	INVESTIGATIONS ON FLY-CONTROL BY COMPOSTING POULTRY-MANURES KEYWORDS TEMPERATURE DEGRA
100 70 0013	POULTRY-MANURE-REM	INFLUENCE OF POULTRY-MANURE-REMOVAL SCHEDULES ON VARIOUS DIPTERA LARVAE AND SELECTED AN
200 73 1093	POULTRY-MANURE-SUP	DEHYDRATED POULTRY MANURE AS A CRUDE PROTEIN SUPPLEMENT FOR SHEEP KEYWORDS
100 71 0748	POULTRY-ODOR	THE ELIMINATION OF ODOR FROM THE EFFLUENT GASES OF CHICKEN MANURE DRYING PLANT KEYWORD
200 69 0170	POULTRY-WASTE	THE VALUE OF HYDROLYZED AND DRIED POULTRY WASTE AS A FEED FOR RUMINANT ANIMALS KEYWORD
300 70 0209	POULTRY-WASTE	THE UTILIZATION OF POULTRY-WASTE AS A FEEDSTUFF FOR GROWING CHICKS KEYWORDS DEHYDRATI
300 71 0624	POULTRY-WASTE	FEEDING DEHYDRATED POULTRY WASTE TO DAIRY COWS KEYWORDS CATTLE DRYING AMINO-ACIDS NITR
300 71 0625	POULTRY-WASTE	THE RELATIONSHIP OF DRYING TEMPERATURE TO TOTAL CRUDE PROTEIN IN DRIED POULTRY WASTE K
300 71 0627	POULTRY-WASTE	DRIED POULTRY WASTE AS A PROTEIN SOURCE FOR FEEDLOT CATTLE KEYWORDS FEED-EFFECIENCY R
100 68 0337	POULTRY-WASTE-DISP	A REVIEW OF POULTRY-WASTE-DISPOSAL POSSIBILITIES KEYWORDS BOD N P K MOISTURE-CONTENT
100 70 0047	PRACTICES	PRINCIPLES AND PRACTICES OF BEEF CATTLE FEEDLOTS KEYWORDS DISEASES COSTS PROFITS NUTR
200 69 0188	PRACTICES	PROBLEMS AND PRACTICES IN SOME SYSTEMS OF MANURE HANDLING IN NORTHERN EUROPE KEYWORDS
100 69 0071	PRECIP	ENGINEERING ANALYSIS OF CATTLE FEEDLOTS TO REDUCE WATER POLLUTION KEYWORDS RUNOFF PRECI
100 66 1080	PRECIPITATION	NITROGEN COMPOUNDS IN NATURAL WATER--A REVIEW KEYWORDS NITROGEN WATER FARM-WASTES GROUN
100 70 0042	PRECIPITATION	STREAM ENRICHMENT FROM FARM OPERATIONS KEYWORDS FERTILIZER N P K NUTRIENT-LOSSES PREC
200 70 0214	PRECIPITATION	RELATIONSHIP OF AGRICULTURE TO SOIL AND WATER POLLUTION KEYWORDS BOD COD FERTILIZERS
300 69 1180	PRECIPITATION	CATTLE FEEDLOT POLLUTION STUDY KEYWORDS CATTLE FEED-LOTS FARM-WASTES WASTE-DISPOSAL RUN
600 69 1005	PRECIPITATION	FACILITY DESIGN KEYWORDS FEED-LOTS RUNOFF WATER-POLLUTION-CONTROL DESIGN FARM-WASTES
200 71 1252	PRECIPITATION-ATMO	NITRATE POLLUTION OF WATER KEYWORDS WATER-POLLUTION-SOURCES GROUNDWATER SURFACE-WATERS
300 71 1058	PRECIPITATION-ATMO	DEVELOPMENT OF A MATHEMETICAL MODEL TO PREDICT THE ROLE OF SURFACE RUNOFF AND GROUNDWA
300 71 1106	PRECIPITATION-ATMO	MANAGING OUR ENVIRONMENT KEYWORDS MANAGEMENT ENVIRONMENT AGRICULTURE WATER-POLLUTION-CO
100 71 1221	PRECISION	DETERMINATION OF MERCURY IN FOOD PRODUCTS AND BIOLOGICAL FLUIDS BY AERATION & FLAMELESS
400 7[illegible] 1191	PRECONDITIONING	MOVE TO NEW LOCATION SOLVES MANY PROBLEMS FOR CUSTOM FEEDER KEYWORDS
300 71 1106	PREDATION	MANAGING OUR ENVIRONMENT KEYWORDS MANAGEMENT ENVIRONMENT AGRICULTURE WATER-POLLUTION-CO
100 70 0013	PREDATORS	INFLUENCE OF POULTRY-MANURE-REMOVAL SCHEDULES ON VARIOUS DIPTERA LARVAE AND SELECTED AN
100 68 0090	PREDICTION-EQUATIO	WILSCHWITZ RUNOFF SAMPLER KEYWORDS NUTRIENTS WATER-LEVEL PREDICTION-EQUATIONS WEIRS
300 46 1208	PRESCRIPTIVE-RIGHT	GREEN V MCCLOUD ACTION TO ENJOIN SEWAGE FLOW KEYWORDS KENTUCKY DOMESTIC-WASTES WATER-PO
600 72 1076	PRESSURE	HIGH-TEMPERATURE HIGH-PRESSURE EXTRUSION OF CHICKEN EXCRETA KEYWORDS FARM-WASTES POULTR
100 64 0333	PRESSURE-BLOWER	AEROBIC-DIGESTION, COMPOSTING OF POULTRY-MANURE KEYWORDS AERATION WINDROW-METHOD PRE
100 66 0341	PREVENTION	AGRICULTURE AND THE PREVENTION OF RIVER-POLLUTION, AS EXPERIENCED IN THE WEST-OF-SCOTLA
100 69 0265	PREVENTION	PENICILLIN BY THE POUND KEYWORDS ANIMAL PATHOLOGY DISEASE RESISTANCE ANTIBIOTICS DISE
200 70 0687	PRE-TREATMENT	OPERATION OF AN ANAEROBIC POND ON HOG ABATTOIR WASTEWATER KEYWORD OPERATING-COSTS EFF
200 71 0274	PRICING	WHAT DO WE MEAN BY POLLUTION KEYWORDS ENVIRONMENT-QUALITY STANDARDS TAXATION PRICING
600 72 1002	PRIMARY-ODOR-LIST	USING ODOR INTENSITY LIMITS IN AIR QUALITY STANDARDS KEYWORDS AIR-POLLUTION ODOUR REGULA
100 71 1232	PRIMATES	WASTE WATER FROM SIMIAN PRIMATE FACILITIES KEYWORDS LABORATORY-ANIMALS WASTE-WATER-TREA
100 70 0047	PRINCIPLES	PRINCIPLES AND PRACTICES OF BEEF CATTLE FEEDLOTS KEYWORDS DISEASES COSTS PROFITS NUTR
100 65 0067	PROBLEM	EFFLUENT DISPOSAL - STILL A MAJOR PROBLEM KEYWORDS SLURRIES SPRINKLER-IRRIGATION PUMPI
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100 67 0104  RAIN                 MODELING FEEDLOT RUNOFF POLLUTION  KEYWORDS  COD DISCHARGE  HYDROGRAPHS CONCENTRATION S
300 68 1202  RAIN                 OWENS V UNITED STATES LIABILITY CF UNITED STATES FOR NEGLIGENT APPLICATION OF INSECTICI
400 71 1139  RAIN                 HOW WEATHER AFFECTS FEEDLOT PERFORMANCE KEYWORDS MUD RAIN WIND FEED-LOTS FARM-WASTES WE
100 69 1198  RAINFALL             CHEMICAL AND DETRITAL FEATURES OF PALOUSE RIVER IDAHO RUNOFF FLOWARE KEYWORDS
100 70 0372  RAINFALL             DRAINAGE AND POLLUTION FROM BEEF CATTLE-FEEDLOTS  KEYWORDS  RUNOFF SURFACE-DRAINAGE GRO
100 70 1233  RAINFALL             LOSSES OF NITROGEN AND PHOSPHORUS FROM AGRICULTURAL LAND KEYWORDS WATER-POLLUTION-SOURC
100 71 0318  RAINFALL             RUNOFF, SOLID WASTES, AND NITRATE MOVEMENT ON BEEF FEEDLOTS KEYWORDS  COD BOD DO SOIL-C
100 73 1087  RAINFALL             ENRICHMENT OF THE ATMOSPHERE WITH NITROGEN COMPOUNDS VOLATILIZED FROM A LARGE DAIRY ARE
200 66 0120  RAINFALL             STORMWATER RUNOFF FROM CATTLE FEEDLOTS  KEYWORDS  STORAGE NITROGEN ORGANIC-WASTE RAINFA
200 68 0726  RAINFALL             ECONOMICS OF WATER POLLUTION CONTROL FOR CATTLE FEEDLOT OPERATIONS KEYWORDS FARM-WASTES
200 69 0184  RAINFALL             TREATMENT OF WASTES FROM BEEF CATTLE FEEDLOTS-FIELD RESULTS  KEYWORDS  ANAEROBIC-CONDIT
200 71 0709  RAINFALL             BEEF CATTLE FEEDLOT WASTE MANAGEMENT PROGRAM  KEYWORDS  RUN-OFF CATTLE WASTE-DILUTION R
200 71 0778  RAINFALL             LAND DISPOSAL OF CATTLE FEEDLOT WASTES  KEYWORDS  RUNOFF LAGOON RAINFALL CORN IRRIGATIO
300 67 0701  RAINFALL             WATER POLLUTION AND AGRICULTURE  KEYWORDS  RUNOFF RAINFALL  BACTERIA BOD COLIFORM FISHK
300 68 0702  RAINFALL             BUFFALO LAKE PROJECT RANDALL COUNTY,TEXAS  KEYWORDS  RUNOFF RAINFALL BACTERIA COLIFORMS
300 68 1202  RAINFALL             OWENS V UNITED STATES LIABILITY OF UNITED STATES FOR NEGLIGENT APPLICATION OF INSECTICI
300 73 1009  RAINFALL             STREAM POLLUTION FROM CATTLE FEEDLOT RUNOFF KEYWORDS WATER-POLLUTION CATTLE FARM-WASTES
200 68 0434  RAINFALL-CONTROL     ECONOMICS OF WATER POLLUTION CONTROL FOR CATTLE FEEDLOT CPERATIONS  KEYWORDS  CONFINEME
200 66 1112  RAINFALL-INTENSITY   CATTLE FEEDLOT RUNOFF NATURE AND BEHAVIOR KEYWORDS WATER-POLLUTION-SOURCES SURFACE-RUNO
600 70 0255  RAINFALL-INTENSITY   EFFECTS OF MANURE-DEPTHS ON RUNOFF FROM SOUTHWESTERN CATTLE-FEEDLOTS  KEYWORDS  RAINFAL
200 69 0423  RAINFALL-RUNOFF      2 ND COMPENDIUM OF ANIMAL WASTE MANAGEMENT KEYWORDS  RAINFALL-RUNOFF EQUIPMENT DESIGN-D
200 69 0428  RAINFALL-RUNOFF      DESIGN FOR FEEDLOT WASTE MANAGEMENT - HISTORY AND CHARACTERISTICS  KEYWORDS  RAINFALL-R
200 69 0430  RAINFALL-RUNOFF      CATTLE FEEDLOT WATER QUALITY HYDROLCGY  KEYWORDS  RAINFALL-RUNOFF BOD PH SIMULATION LIQ
300 70 0010  RAINFALL-RUNOFF      THE EFFECT OF ANIMAL-DENSITY AND SURFACE-SLOPE ON CHARACTERISTICS OF RUNOFF, SOLID-WAST
300 72 1085  RAINFALL-RUNOFF-RE   CHARACTERISTICS OF RAINFALL RUNOFF FROM A BEEF CATTLE FEEDLCT KEYWORDS
600 70 0255  RAINFALL-RUNOFF      EFFECTS OF MANURE-DEPTHS ON RUNOFF FROM SOUTHWESTERN CATTLE-FEEDLOTS  KEYWORDS  RAINFAL
200 69 0182  RAINFALL-SIMULATOR   CATTLE FEEDLOT WATER QUALITY HYDROLCGY  KEYWORDS  HYDROGRAPHS RAINFALL-SIMULATORS INTEN
200 69 0189  RANKING              MEASUREMENT OF THE ODOR STRENGTH OF ANIMAL MANURES  KEYWORDS POULTRY ODOR-STRENGTH VAPO
200 66 0144  RAPPAHANNOCK-RIVER   TREATMENT OF DUCK WASTES AND THEIR EFFECTS ON WATER QUALITY KEYWORDS  COLIFORMS BOD POU
200 69 0056  RATE                 PRELIMINARY RESULTS OF A NOVEL BIOLOGICAL PROCESS FOR TREATING DAIRY WASTES  KEYWORDS
100 70 0458  RATES                USE OF SOIL TO TREAT ANAEROBIC LAGOON EFFLUENT  DESIGN AND OPERATION OF A FIELD DISPOSA
300 68 0256  RATES                USE ANIMAL MANURE EFFECTIVELY KEYWORDS  FERTILIZERS SALTS COMPOSTING RATES RETURNS BENE
600 71 0271  RATES                GROWING CORN IN GROWTH CHAMBERS WITH DIFFERENT MANURE TREATMENTS  KEYWORDS  DISPOSAL CR
100 70 0021  RATES-OF-APPLICATI   EFFECT OF MANURE APPLICATION, AERATION, AND SOIL PH ON SOIL NITROGEN TRANSFORMATIONS AN
300 72 1052  RATES-OF-APPLICATI   EFFECT OF ANIMAL WASTES APPLIED TC SOILS ON SURFACE AND GROUNDWATER SYSTEMS KEYWORDS
600 72 1177  RATES-OF-APPLICATI   DISPOSAL OF BEEF FEEDLOT WASTES ONTO CROPLAND KEYWORDS FARM-WASTES WASTE-DISPOSAL CATTL
300 71 0466  RATE-OF-CONCENTRAT   INFILTRATION RATES AND GROUNDWATER QUALITY BENEATH CATTLE FEEDLOTS TEXAS HIGH PLAINS KE
300 69 0006  RATE-OF-FLOW         SWINE WASTE MANAGEMENT-OXIDATION DITCH FOR TREATING HOG WASTES-FACT SHEET  KEYWORDS  DE
400 65 0485  RATE-OF-GAIN         POULTRY LITTER AS CATTLE FEED  KEYWORDS  LEGAL-ASPECTS HAZARDS BLOAT EFFICIENCIES RATE-
100 64 0333  RATIO                AEROBIC-DIGESTION, COMPOSTING  OF POULTRY-MANURE  KEYWORDS  AERATION WINDROW-METHOD PRE
100 64 0072  RATION               A NOTE ON THE UTILIZATION BY CHICKENS OF ENERGY FROM FAECES KEYWORDS  WHEAT SORGUUM NIT
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200 73 1062 RATION CONTINUED RECYCLING OF CATTLE MANURE KEYWORDS CATTLE FARM-WASTES RECYCLING NITROGEN CAL
400 70 0109 RATION SOME CAUSES OF WET POULTRY MANURE KEYWORDS MOISTURE-CONTENT WATER-CONSUMPTION STRAINS
600 73 1075 RATION THE EFFECT OF RATION ON ENGINEERING PROPERTIES OF BEEF CATTLE MANURE KEYWORDS
200 69 0170 RATIONS THE VALUE OF HYDROLYZED AND DRIED POULTRY WASTE AS A FEED FOR RUMINANT ANIMALS KEYWORD
100 69 0071 RATION-COMPOSITION ENGINEERING ANALYSIS OF CATTLE FEEDLOTS TO REDUCE WATER POLLUTION KEYWORDS RUNOFF PRECI
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100 70 1217 REACREATION APPLYING BACTERIOLOGICAL PARAMETERS TO RECREATIONAL WATER QUALITY KEYWORDS REACREATION
100 65 0334 REACTIONS CHEMICAL AND BIOLOGICAL REACTIONS FROM LAGOONS USED FOR CATTLE KEYWORDS OXIDATION-LAG
200 69 0191 REACTION-TEMPERATU CHEMICAL ASPECTS OF ODOR REMOVAL IN SOME SOIL SYSTEMS KEYWORDS HYDROGEN-SULFIDE SOIL-
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200 71 0616 REAP THE LAKE MENDOTA WATERSHED PROJECT KEYWORDS ADMINISTRATIVE-AGENCIES GOVERNMENT-SUPPOR
200 71 0620 REAP RECOMMENDATIONS OF NATIONAL MILK PRODUCERS FEDERATION KEYWORDS ADMINISTRATIVE-AGENCIE
300 30 1205 REASONABLE-USE SUMNER V ODELL INJUNCTION TO PREVENT POLLUTION OF SPRING WATER BY CATTLE KEYWORDS
300 49 1210 REASONABLE-USE MEASURE AND ELEMENTS OF DAMAGES FOR POLLUTION OF A STREAM KEYWORDS JUDICIAL-DECISIONS D
200 70 0242 RECIRCULATED MINIMIZING THE WASTE DISPOSAL PROBLEM IN VEGETABLE PROCESSING KEYWORDS COD BOD REVERS
400 71 0339 RECIRCULATED FLUSHING AWAY MANURE PROBLEMS KEYWORDS RECIRCULATED WATER HOGS OXIDATION-DITCH FLUSHI
100 65 0331 RECIRCULATED-WATER DISPOSAL OF DAIRY-MANURE KEYWORDS SEPTIC-TANK AESTHETICS EFFICIENCIES RECIRCULATED-W
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400 70 0097 RECIRCULATED-WATER POULTRY MANURE LAGOON DESIGN KEYWORDS RECIRCULATED-WATER AERATION EQUIPMENT COSTS FL
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300 70 0668 RECLAMATION PHOTOSYNTHETIC RECLAMATION OF AGRICULTURAL SOLID AND LIQUID WASTE KEYWORDS ALGAE RECL
100 71 0571 RECOVERY EFFECT OF METHOD OF MANURE HANDLING ON CROP YIELDS, NUTRIENT RECOVERY AND RUNOFF LOSSES
100 72 1199 RECOVERY IMPROVED PROCEDURES FOR THE DETERMINATION OF OXYTETRACYCLINE IN MILK MILK PRODUCTS CHIC
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100 69 1231 RECREATION POLLUTION AND EUTROPHICATION PROBLEMS OF GREAT SOUTH BAY LONG ISLAND, NEW YORK KEYWORDS
100 70 0051 RECREATION IMPACT OF AGRICULTURAL POLLUTANTS ON WATER USES KEYWORDS BOD COD DISPOSAL IRRIGATION L
100 71 1212 RECREATION EFFECTS OF MULTIPLE USE ON WATER QUALITY OF HIGH MOUNTAIN WATERSHEDS BACTERIOLOGICAL IN
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300 49 1210 RECREATION MEASURE AND ELEMENTS OF DAMAGES FOR POLLUTION OF A STREAM KEYWORDS JUDICIAL-DECISIONS D
300 68 0702 RECREATION BUFFALO LAKE PROJECT RANDALL COUNTY,TEXAS KEYWORDS RUNOFF RAINFALL BACTERIA COLIFORMS
[illegible]00 70 0406 RECREATION EFFECTS OF AGRICULTURAL-POLLUTANTS ON RECREATIONAL-USES OF SURFACE-WATERS KEYWORDS R
300 64 1110 RECREATIONAL-USE LAKE TERMINOLOGY WATER BLOOM KEYWORDS EUTROPHICATION ALGAE DUCKS COLOR FISHKILL LAKES
200 69 1117 RECREATION-WASTES WATER POLLUTION BY NUTRIENTS--SOURCES EFFECTS AND CONTROL PAPERS PRESENTED AT 1966 ANNU
600 69 1006 RECTAL-TEMPERATURE HYPOTHALAMIC TEMPERATURE REGULATION IN CATTLE KEYWORDS CATTLE TEMPERATURE-CONTROL HUMID
300 69 0093 RECURRENCE-INTERVA HYDROLOGIC ASPECTS OF FEEDLOT WASTE CONTROL KEYWORDS BOD DO RIVERS WATER-QUALITY STREAM
200 68 0725 RECYCLE POLLUTION CONTROL IN CATTLE FEEDLOTS THROUGH THE USE OF MANURE AS FEED KEYWORDS SILAG
[illegible] 71 0785 RECYCLE A TOTAL BIOCHEMICAL RECYCLE PROCESS FOR CATTLE WASTES KEYWORDS LIQUID-WASTES PHOSPHAT
300 71 1238 RECYCLE CLOSED SYSTEM WASTE MANAGEMENT FOR LIVESTOCK KEYWORDS VIBRATING-SCREEN HYDRAULIC-TRANSP
200 71 0844 RECYCLED REGULATORY ASPECTS OF RECYCLED LIVESTOCK AND POULTRY WASTES KEYWORD ADMINISTRATIVE AG
400 71 0327 RECYCLED RECYCLED POULTRY NUTRIENTS KEYWORDS FARM-WASTES POULTRY WASTE-DISPOSAL DRIED-POULTRY
300 71 1238 RECYCLED-WASHWATER CLOSED SYSTEM WASTE MANAGEMENT FOR LIVESTOCK KEYWORDS VIBRATING-SCREEN HYDRAULIC-TRANSP
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100 65 1079 RECYCLING UTILIZATION OF DIFFERENT LEVELS OF POULTRY LITTER NITROGEN BY SHEEP KEYWORDS
100 72 0746 RECYCLING RECYCLING SYSTEM FOR POULTRY WASTES KEYWORD NITROGEN LAGOON PUMPING AEROBIC BIOCHEMIC
100 73 1086 RECYCLING THE EFFECT OF FEEDING LAYING HENS VARIOUS LEVELS OF COW MANURE ON THE PIGMENTATION OF E
100 73 1104 RECYCLING ANIMAL WASTE MANAGEMENT IN HAWAII KEYWORDS FARM-WASTES LIVESTOCK WASTE-DISPOSAL WASTE-T
200 70 0325 RECYCLING RECYCLING AND-UTILIZATION OF BIODEGRADABLE-WASTES IN THE SOIL KEYWORDS BIOLOGICAL-SYST
200 71 0802 RECYCLING AUTOMATED HANDLING, TREATMENT AND RECYCLING OF WASTE WATER FROM AN ANIMAL CONFINEMENT
200 71 0845 RECYCLING CATTLE MANURE AS FEED FOR CATTLE KEYWORD RECYCLING ANIMAL-PATHOLOGY MICROORGANISMS NE
200 71 0846 RECYCLING NUTRITIVE VALUE OF CHICKEN MANURE FOR CATTLE KEYWORDS FARM-WASTES RECYCLING CATTLE POUL
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200 71 0851 RECYCLING NUTRITIVE EVALUATIONS OF UNTREATED AND CHEMICALLY TREATED DAIRY CATTLE WASTES KEYWORDS
200 71 0852 RECYCLING BIODEGRADED HEN MANURE AND ADULT HOUSE FLIES THEIR NUTRITIONAL VALUE TO THE GROWING CH
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200 71 0858 RECYCLING RENOVATION AND REUSE OF WATER FOR DILUTION AND HYDRAULIC TRANSPORT OF DAIRY CATTLE MANU
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200 72 1021 RECYCLING APPLICATION UTILIZATION AND DISPOSAL OF LIVESTOCK WASTES KEYWORDS FARM-WASTES FEED-LOTS
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200 72 1025 RECYCLING OTHER RESEARCH NEEDS KEYWORDS FARM-WASTES PROTEINS RUNOFF FEED-LOTS WASTE-DISPOSAL
200 72 1030 RECYCLING RECOVERY OF ANIMAL FEED FROM CATTLE MANURE KEYWORDS RECYCLING FARM-WASTES CATTLE FEED-L
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400 73 1068 RECYCLING NEW FEEDLOT CONCEPT USES CONVERTED MANURE AS FEED KEYWORDS RECYCLING FARM-WASTES CATTLE
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100 71 0261 REDUCTION ANAEROBIC DIGESTION OF FARM ANIMAL WASTES DAIRY BULL, SWINE,AND POULTRY KEYWORDS SLUD
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300	70	1104	SALMONELLA	FISH AS POTENTIAL VECTORS OF HUMAN BACTERIAL DISEASES KEYWORDS DISEASES VECTROS-BIOLOGY
400	67	0336	SALMONELLA	DISPOSAL OF FARM EFFLUENT KEYWORDS SALMONELLA SLURRIES DISEASE-HAZARD ANTHRAX ENGLAND
100	70	0110	SALMONELLAE	ISOLATION OF SALMONELLAE FROM RENDERED BY-PRODUCTS AND POULTRY LITTER CULTURED IN ENRIC
100	70	0024	SALMONELLAE	PROBABLE SOURCES OF SALMONELLAE ON A POULTRY FARM KEYWORDS INVESTIGATIONS ANIMALS RODEN
100	71	0444	SALMONELLA-CONTAMI	PROLONGED SALMONELLA CONTAMINATION OF A RECREATIONAL LAKE BY RUNOFF WATERS KEYWORDS SA
100	69	0736	SALMONELLA-ISOLATI	SALMONELLA IN WASTES PRODUCED AT COMMERCIAL POULTRY FARMS KEYWORDS SALMONELLA-ISOLATION
100	71	1213	SALMONELLA-TYPHOSA	A COMPUTER PROGRAM FOR IDENTIFYING MICROORGANISMS KEYWORDS PATHOGENIC-BACTERIA ENTERIC-
200	66	0118	SALMONELLOSIS	HEALTH ASPECTS AND VECTOR CONTROL ASSOCIATED WITH ANIMAL WASTES KEYWORDS PUBLIC-HEALT
400	66	0354	SALMONELLOSIS	SALMONELLOSIS IN CATTLE KEYWORDS PATHOGENIC-BACTERIA CARRIERS ENGLAND CLINICAL-SIGNS
100	70	1051	SALMONIDS	POLLUTION POTENTIAL OF SALMONID FISH HATCHERIES KEYWORDS FISH-HATCHERIES SALMONIDS SOUR
110	70	1237	SALMONIDS	POLLUTION POTENTIAL OF SALMONID FISH HATCHERIES KEYWORDS SOURCES FISH-HATCHERIES SALMON
300		1077	SALT	SOIL CONDITIONS UNDER FEEDLOTS AND ON LAND TREATED WITH LARGE AMOUNTS OF ANIMAL WASTES
400	70	0109	SALT	SOME CAUSES OF WET POULTRY MANURE KEYWORDS MOISTURE-CONTENT WATER-CONSUMPTION STRAINS
300	70	0491	SALTON-SEA-CAL	WATER-QUALITY CONTROL PROBLEMS IN INLAND-SINKS KEYWORDS SALINITY EUTROPHICATION PYRAMI
200	69	0431	SALTS	MAJOR PROBLEMS OF WATER POLLUTION CREATED BY AGRICULTURAL PRACTICES KEYWORDS EROSION
200	70	0217	SALTS	POLLUTION FACTORS ASSOCIATED WITH EXCESSIVE POULTRY-LITTER MANURE APPLICATION IN ARKA
200	71	0830	SALTS	FATE OF INORGANIC FORMS OF N AND SALT FROM LAND-DISPOSED MANURES FROM DAIRIES KEYWORDS
300	68	0256	SALTS	USE ANIMAL MANURE EFFECTIVELY KEYWORDS FERTILIZERS SALTS COMPOSTING RATES RETURNS BENE
300	71	1107	SALTS	WATER POLLUTION CONTROL LEGISLATION AGRICULTURAL RUNOFF PART 6 KEYWORDS AGRICULTURAL-C
400	73	1168	SALTS	CALIFORNIA WASTE PONDS ARE PASSING THE TEST KEYWORDS IRRIGATION-STORAGE-PONDS LEACHING
600	73	1065	SALTS	EFFECTS OF SWINE LAGOON EFFLUENT OF THE SOIL AND PLANT TISSUE KEYWORDS
300	70	0490	SALT-BALANCE	SALINITY-CONTROL IN RETURN-FLOW FROM IRRIGATED AREAS A DEMONSTRATION-PROJECT KEYWORDS
300	70	1036	SALT-TOLERANCE	AGRICULTURE THE UNSEEN FOE IN THE WAR ON POLLUTION KEYWORDS AGRICULTURE WATER-POLLUTIO
100	68	0090	SAMPLER	WILSCHWITZ RUNOFF SAMPLER KEYWORDS NUTRIENTS WATER-LEVEL PREDICTION-EQUATIONS WEIRS
100	65	1079	SAMPLES	UTILIZATION OF DIFFERENT LEVELS OF POULTRY LITTER NITROGEN BY SHEEP KEYWORDS
100	72	1097	SAMPLES	NITRATE CONCENTRATIONS IN GROUNDWATER BENEATH A BEEF CATTLE FEEDLOT KEYWORDS
100	71	0441	SAMPLE-PREPARATION	METHODS OF SAMPLE PREPARATION FOR CHEMICAL DETERMINATION OF CHROMIC OXIDE IN BOVINE FEC
100	71	1221	SAMPLE-PREPARATION	DETERMINATION OF MERCURY IN FOOD PRODUCTS AND BIOLOGICAL FLUIDS BY AERATION & FLAMELESS
100	72	1215	SAMPLE-PREPARATION	AUTOMATED COMBUSTION VERSUS DIGESTION FOR TRITIUM MEASUREMENT IN BIOLOGICAL SAMPLES KE
100	65	0075	SAMPLING	HOG-WASTE-DISPOSAL BY LAGOONING KEYWORDS ODOR BOD COD E-COLI SAMPLING SEPTIC-TANKS ALGA
100	69	0375	SAMPLING	RURAL-RUNOFF AS A FACTOR IN STREAM-POLLUTION KEYWORDS WATER-QUALITY SOIL-EROSION COLIF
100	69	0690	SAMPLING	AN IMPROVED METHOD FOR SEPARATE COLLECTION OF URINE FECES AND EXPIRATORY GASES FROM T
100	70	0013	SAMPLING	INFLUENCE OF POULTRY-MANURE-REMOVAL SCHEDULES ON VARIOUS DIPTERA LARVAE AND SELECTED AN
100	71	0484	SAMPLING	RELATIONSHIPS OF SALMONELLA TO FECAL COLIFORMS IN BOTTOM SEDIMENTS KEYWORD INDICATORS
100	71	0722	SAMPLING	THE USE OF FLUORESCENT ANTIBODY TECHNIQUES FOR DETECTION OF STREPTOCOCCUS FAECALIS AS A
100	71	1212	SAMPLING	EFFECTS OF MULTIPLE USE ON WATER QUALITY OF HIGH MOUNTAIN WATERSHEDS BACTERIOLOGICAL IN
100	71	1232	SAMPLING	WASTE WATER FROM SIMIAN PRIMATE FACILITIES KEYWORDS LABORATORY-ANIMALS WASTE-WATER-TREA
100	73	1087	SAMPLING	ENRICHMENT OF THE ATMOSPHERE WITH NITROGEN COMPOUNDS VOLATILIZED FROM A LARGE DAIRY ARE
200	71	0703	SAMPLING	FEEDLOT WASTE MANAGEMENT SOME SOLUTIONS TO THE PROBLEM KEYWORDS MOISTURE-CONTENT SAM
200	71	0832	SAMPLING	GROUNDWATER POLLUTION DUE TO HIGH ORGANIC MANURE LOADINGS KEYWORDS WATER-POLLUTION SA
300	71	0697	SAMPLING	ROLE OF ANIMAL WASTES IN AGRICULTURAL LAND RUNOFF KEYWORD WATER-POLLUTION FARM-LAGOON
300	71	1057	SAMPLING	EFFECTS OF POLLUTION ESPECIALLY FROM FEEDLOTS ON FISHES IN THE UPPER NEOSHO RIVER BASI
700	70	1066	SAMPLING	WATER POLLUTION BY SWINE PRODUCTION OPERATIONS KEYWORDS EFFLUENT WASTE-DISPOSAL HYDROGR
700	70	1109	SAMPLING	AN EVALUATION OF AN ANAEROBIC LAGOON TREATING SWINE WASTES KEYWORDS FARM-WASTES HOGS A
100	72	1224	SANDS	FACTORS AFFECTING THE CONCENTRATION OF FAECAL BACTERIA BACTERIA IN LAND DRAINAGE WATER
700	72	1048	SANDS	SPRINKLER APPLICATION OF ANAEROBICALLY TREATED SWINE WASTES AS LIMITED BY NITROGEN CONC
700	70	1256	SANDY-LOAM-LAND-DI	MOVEMENT OF POLLUTANT PHOSPHORUS IN SATURATED SOILS KEYWORDS PHOSPHATES SOIL CONTAMINAT
200	64	1240	SANITARY-ENGINEERI	THE PHYSIOLOGY OF THE COLIFORM GROUP KEYWORDS BACTERIA COLIFORMS POLLUTANTS SANITARY-E
100	60	0059	SANITATION	THE MANAGEMENT OF LIVESTOCK MANURE KEYWORDS DISPOSAL VALUE STORAGE CN-RATIO COMPOSTIN
200	66	0127	SANITATION	CATTLE-MANURE HANDLING AND DISPOSAL SYSTEMS ON THE WEST COAST KEYWORDS CATTLE LOADING
100	70	1237	SAN-JOAQUIN-RIVER-	POLLUTION POTENTIAL OF SALMONID FISH HATCHERIES KEYWORDS SOURCES FISH-HATCHERIES SALMON
600	69	1239	SAN-JOAQUIN-VALLEY	DRAIN INSTALLATION FOR NITRATE REDUCTION KEYWORDS CALIFORNIA DRAINS INSTALLATION NITRAT
100	71	1213	SARCINA-LUTEA	A COMPUTER PROGRAM FOR IDENTIFYING MICROORGANISMS KEYWORDS PATHOGENIC-BACTERIA ENTERIC-
700	70	1256	SATURATED-SOILS	MOVEMENT OF POLLUTANT PHOSPHORUS IN SATURATED SOILS KEYWORDS PHOSPHATES SOIL-CONTAMINAT
200	71	0805	SAWDUST	HIGH RATE POULTRY MANURE COMPOSTING WITH SAWDUST KEYWORDS AEROBIC-TREATMENT COMPOSTIN
700	69	1067	SCHEDULING-MODEL	ANALYSIS OF ANIMAL WASTE STORAGE AND LAND DISPOSAL SYSTEMS KEYWORDS FARM-WASTES ODOR W
700	70	1256	SCINTILLATOR	MOVEMENT OF POLLUTANT PHOSPHORUS IN SATURATED SOILS KEYWORDS PHOSPHATES SOIL-CONTAMINAT
300	65	0053	SCRAPERS	FARMYARD MANURE HANDLING KEYWORDS DISPOSAL EQUIPMENT OPERATIONS MACHINERY LOADERS SCR
200	71	0858	SCREENS	RENOVATION AND REUSE OF WATER FOR DILUTION AND HYDRAULIC TRANSPORT OF DAIRY CATTLE MANU
200	69	0531	SCS	TECHNICAL-ASSISTANCE AVAILABLE FROM THE SOIL-CONSERVATION SERVICE KEYWORDS SCS SURFAC
200	71	0282	SCS	SEDIMENT EVERYBODY S POLLUTION-PROBLEM KEYWORDS EROSION SEDIMENTATION SCS WATERSHED
200	71	0611	SCS	U S D A TECHNICAL AND FINANCIAL ASSISTANCE PROGRAMS KEYWORDS ADMINISTRATIVE-AGENC
200	71	0615	SCS	FINANCIAL ASSISTANCE FOR THE CONSTRUCTION AND IMPROVEMENT OFIRRIGATION SYSTEMS KEYWORD
200	71	0616	SCS	THE LAKE MENDOTA WATERSHED PROJECT KEYWORDS ADMINISTRATIVE-AGENCIES GOVERNMENT-SUPPOR
400	68	0038	SCS	PONDS STOP POLLUTION FROM FEEDLOTS KEYWORDS PONDS KANSAS WATER-QUALITY-ACT DAMS RUNO
400	68	0229	SCS	THE FARM ROLE IN WATER-QUALITY MANAGEMENT KEYWORDS SEDIMENT FERTILIZERS WATER-POLLUTIO
100	70	0089	SEA	TREATMENT, USE, AND DISPOSAL OF WASTES FROM MODERN AGRICULTURE KEYWORDS AERATION ODOR
100	71	0567	SEAGULL	BACTERIAL AND FUNGAL FLORA OF SEAGULL DROPPINGS IN JERSEY KEYWORDS BACTERIAL FLORA SEA
600	72	1148	SEALING	DAIRY WASTE PONDS EFFECTIVELY SELF SEALING KEYWORDS GROUNDWATER-POLLUTION FARM-WASTES I
300	71	1100	SEALS-ANIMALS	DETERMINATION ON MERCURY IN SAMPLES FROM THE DUTCH ENVIRONMENT KEYWORDS MERCURY NEUTRO
100	68	0011	SEARCH	THE SEARCH FOR NEW POULTRY LITTER MATERIALS-AN EXAMPLE OF COOPERATION BETWEEN EXTENSION
300	69	0003	SEASON	CONFINEMENT SWINE HOUSING - SPACE REQUIREMENTS-FACTSHEET KEYWORDS SIZE TEMPERATURE SEA
300	72	1070	SEASONAL-GROWTH	PERIODICITY OF THE BLUE-GREEN ALGAE AND THEIR EFFECT ON THE EFFICIENCY OF MANURE-DISPOS
100	68	0381	SECONDARY-DITCH	WASTES FROM PIG-PRODUCTION UNITS KEYWORDS OXIDATION-DITCH EFFLUENT BOD LININGS SECOND
100	70	1195	SEDIMENT	AGRICULTURAL POLLUTION OF WATER BODIES KEYWORDS WATER-POLLUTION FARMS LIVESTOCK PHOSPHO
200	69	0423	SEDIMENT	2 NL COMPENDIUM OF ANIMAL WASTE MANAGEMENT KEYWORDS RAINFALL-RUNOFF EQUIPMENT DESIGN-D
200	69	0432	SEDIMENT	AGRICULTURE AS A SOURCE OF WATER POLLUTION KEYWORDS LEGISLATION SEDIMENT CHEMICALS LI
300	72	1260	SEDIMENT	NONPOINT RURAL SOURCES OF WATER POLLUTION KEYWORDS WATER POLLUTION RURAL AREAS FERTILIZ
400	68	0229	SEDIMENT	THE FARM ROLE IN WATER-QUALITY MANAGEMENT KEYWORDS SEDIMENT FERTILIZERS WATER-POLLUTIO
500	70	0388	SEDIMENT	CHEMISTRY OF SEDIMENT IN WATER KEYWORDS NITROGEN PHOSPHORUS WATER-POLLUTION CLAYS ORG
200	66	0134	SEDIMENTATION	OPERATING CHARACTERISTICS OF TWO AEROBIC-ANAEROBIC DAIRY MANURE TREATMENT SYSTEMS KEYW
200	66	0135	SEDIMENTATION	TRICKLING FILTERS AS A DAIRY-MANURE STABILIZATION COMPONENT KEYWORDS BOD LABORATORY TE
200	69	0433	SEDIMENTATION	EFFECT OF AGRICULTURE ON WATER QUALITY KEYWORDS EROSION SEDIMENTATION NUTRIENTS RUNOF
200	71	0282	SEDIMENTATION	SEDIMENT EVERYBODY S POLLUTION-PROBLEM KEYWORDS EROSION SEDIMENTATION SCS WATERSHED
200	71	0859	SEDIMENTATION	THE SEPARATION OF SOLID AND LIQUID PARTS OF PIG SLURRY KEYWORD SIEVE-ANALYSIS SEDIMEN
200	71	1095	SEDIMENTATION	BIOLOGICAL ASPECTS OF AGRICULTURES EFFECTS ON ENVIRONMENTAL QUALITY KEYWORDS
[illegible]	70	1036	SEDIMENTATION	AGRICULTURE THE UNSEEN FOE IN THE WAR ON POLLUTION KEYWORDS AGRICULTURE WATER-POLLUTIO
[illegible]	71	1008	SEDIMENTATION	ANIMAL WASTE DISPOSAL AND CONTROL OF FEEDLOT RUNOFF KEYWORDS FEED-LOTS WASTE-DISPOSAL R
700	70	1109	SEDIMENTATION	AN EVALUATION OF AN ANAEROBIC LAGOON TREATING SWINE WASTES KEYWORDS FARM-WASTES HOGS A
[illegible]	69	0168	SEDIMENTATION-TANK	AEROBIC DIGESTION OF DILUTED ANIMAL MANURE IN CLOSED SYSTEMS-TEMPORARY EXPEDIENT OR LON
[illegible]	70	0365	SEDIMENTCHALLANGES	AGRICULTURE FACES NEW CHALLANGES IN CURRENT ENVIRONMENTAL CRISIS KEYWORDS WATER SALIN
[illegible]	64	1200	SEDIMENTS	PROGRESSIVE CHANGES IN THE CLADOCERAN AND MIDGE FAUNA DURING THE ONTOGENY OF ESTHWAITE
[illegible]	68	1121	SEDIMENTS	WATER POLLUTION FROM LAND RUNOFF KEYWORDS RUNOFF WATER-POLLUTION INFILTRATION SEDIMENTS
[illegible]	[illegible]	1196	SEDIMENTS	CHEMICAL AND DETRITAL FEATURES OF PALOUSE RIVER IDAHO RUNOFF FLOWARE KEYWORDS

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300 69 1103  SEDIMENTS          ENFORCEMENT OF WATER POLLUTION LAWS IN OKLAHOMA KEYWORDS OKLAHOMA WATER-POLLUTION-SOURC
300 71 1100  SEDIMENTS          DETERMINATION ON MERCURY IN SAMPLES FROM THE DUTCH ENVIRONMENT  KEYWORDS MERCURY NEUTRO
300 71 1106  SEDIMENTS          MANAGING OUR ENVIRONMENT KEYWORDS MANAGEMENT ENVIRONMENT AGRICULTURE WATER-POLLUTION-CO
500 71 1254  SEDIMENTS          ISOLATION OF ANAEROBES KEYWORDS  ISOLATION CULTURES SOIL-BACTERIA PROTOZOA FUNGI PHOTOS
700 72 1049  SEDIMENTS          ECONOMICS OF WATER QUALITY MANAGEMENT  EXEMPLIFIED BY SPECIFIED POLLUTANTS IN AGRICULTU
300 70 1036  SEDIMENT-CONTROL   AGRICULTURE  THE UNSEEN FOE IN THE WAR ON POLLUTION KEYWORDS AGRICULTURE WATER-POLLUTIO
400 71 1196  SEDIMENT-DISCHARGE CATTLE FEEDERS MUST COMPLY WITH ANTI POLLUTION LAWS KEYWORDS LEGAL-ASPECTS POLLUTION-AB
300 68 1043  SEDIMENT-LOAD      WASTES IN RELATION TO AGRICULTURE AND FORESTRY KEYWORDS SOURCES WATER-POLLUTION-EFFECTS
200 71 0804  SEDIMENT-TRANSPORT IMPROVING WATER UTILIZATION EFFICIENCY IN AUTOMATIC HYDRAULIC WASTE REMOVAL  KEYWORDS
500 70 0387  SEDIMENT-TRANSPORT POLLUTION BY SEDIMENT  SOURCES AND THE DETACHMENT AND TRANSPORT-PROCESSES  KEYWORDS  SE
100 70 1217  SEDIMENT-WATER-INT APPLYING BACTERIOLOGICAL PARAMETERS TO RECREATIONAL WATER QUALITY  KEYWORDS REACREATION
100 71 0484  SEDIMENT-WATER-INT RELATIONSHIPS OF SALMONELLA TO FECAL COLIFORMS IN BOTTOM SEDIMENTS  KEYWORD  INDICATORS
100 68 1121  SEDIMENT-YIELD     WATER POLLUTION FROM LAND RUNOFF KEYWORDS RUNOFF WATER-POLLUTION INFILTRATION SEDIMENTS
500 70 0389  SEDIMENT-YIELD     LAND AND WATER-MANAGEMENT FOR MINIMIZING SEDIMENT  KEYWORDS SOIL-EROSION SEDIMENT-YIELD
100 72 1224  SEEPAGE            FACTORS AFFECTING THE CONCENTRATION OF FAECAL BACTERIA BACTERIA IN LAND DRAINAGE WATER
200 71 1252  SEEPAGE            NITRATE POLLUTION OF WATER KEYWORDS WATER-POLLUTION-SOURCES GROUNDWATER SURFACE-WATERS
300 46 1207  SEEPAGE            FAIRES V DUPREE WATER POLLUTION FROM ANIMAL WASTES KEYWORDS ARKANSAS HOGS ANIMAL-WASTES
600 72 1156  SEEPAGE            SEEPAGE LOSSES AND FERTILIZER PRESERVATION IN MANURE STACKING PRACTICE KEYWORDS
100 73 1164  SEFTENBERG         SALMONELLA IN THE LAYING HEN I SALMONELLA RECOVERY FROM VISCERA FECES AND EGGS FOLLOWIN
200 66 0123  SELECTION-CRITERIA PUMPING MANURE SLURRIES  KEYWORDS  PUMPS SLURRIES CAPACITY  EFFICIENCIES HANDLING SELEC
100 69 0714  SELENITE           EVALUATION OF CULTURE MEDIA FOR THE ISOLATION OF SALMONELLA FROM FECES KEYWORDS
200 71 0640  SEPARATION         HANDLING LIVESTOCK WASTE  KEYWORDS  TREATMENT OXIDATION-LAGOONS DISPOSAL DRYING SEPARAT
100 70 0270  SEPARATION-TECHNIQ RAPID CONCENTRATION OF STRONGYLE EGGS FROM EQUINE FECES FOR IN VITRO STUDIES  KEYWORDS
300 71 1100  SEPARATION-TECHNIQ DETERMINATION ON MERCURY IN SAMPLES FROM THE DUTCH ENVIRONMENT  KEYWORDS MERCURY NEUTRO
200 71 0859  SEPERATION         THE SEPARATION OF SOLID AND LIQUID PARTS OF PIG SLURRY  KEYWORD  SIEVE-ANALYSIS SEDIMEN
100 65 0331  SEPTIC-TANK        DISPOSAL OF DAIRY-MANURE  KEYWORDS  SEPTIC-TANK AESTHETICS  EFFICIENCIES RECIRCULATED-W
100 69 0035  SEPTIC-TANK        TREATMENT OF BEEF-CATTLE WASTE WATER FOR POSSIBLE REUSE KEYWORDS  BOD COD PH SEPTIC-TAN
200 71 0665  SEPTIC-TANK        WASTE MANAGEMENT ON A MODERN DAIRY FARM  KEYWORDS  CATTLE SOIL-DISPOSAL-FIELDS SEPTIC-T
100 65 0075  SEPTIC-TANKS       HOG-WASTE-DISPOSAL BY LAGOONING KEYWORDS ODOR BOD COD E-COLI SAMPLING SEPTIC-TANKS ALGA
100 65 0366  SEPTIC-TANKS       LIQUID HANDLING OF POULTRY MANURE  KEYWORDS  SLUDGE ODOR DISPOSAL DESIGN-CRITERIA RECYC
200 66 0128  SEPTIC-TANKS       MACERATION FOR DISPOSAL OF DEAD POULTRY  KEYWORDS  DISPOSAL LAGOONS SEPTIC-TANKS EQUIPM
200 66 0131  SEPTIC-TANKS       DISPOSAL OF HOUSEHOLD WASTES IN THE SOIL  KEYWORDS  SEWERS  SEPTIC-TANKS ABSORPTION SOI
200 69 1117  SEPTIC-TANKS       WATER POLLUTION BY NUTRIENTS--SOURCES EFFECTS AND CONTROL PAPERS PRESENTED AT 1966 ANNU
300 68 0352  SEPTIC-TANKS       DISPOSAL OF WASTES FROM SWINE FEEDING FLOORS TO MINIMIZE STREAM POLLUTION  KEYWORDS  SE
300 71 0457  SEPTIC-TANKS       DISPOSAL OF LIQUID WASTES FROM PARLORS AND MILK HOUSES  KEYWORD  AEROBIC-TREATMENT SPRI
100 64 1200  SERGENTIA          PROGRESSIVE CHANGES IN THE CLADOCERAN AND MIDGE FAUNA DURING THE ONTOGENY OF ESTHWAITE
100 71 1213  SERRATIA           A COMPUTER PROGRAM FOR IDENTIFYING MICROORGANISMS KEYWORDS PATHOGENIC-BACTERIA ENTERIC-
100 71 1213  SERRATIA-MARCESENS A COMPUTER PROGRAM FOR IDENTIFYING MICROORGANISMS KEYWORDS PATHOGENIC-BACTERIA ENTERIC-
100 69 1198  SESTON             CHEMICAL AND DETRITAL FEATURES OF PALOUSE RIVER IDAHO RUNOFF FLOWARE KEYWORDS
100 70 1237  SETTLEABLE-SOLIDS  POLLUTION POTENTIAL OF SALMONID FISH HATCHERIES KEYWORDS SOURCES FISH-HATCHERIES SALMON
200 71 0640  SETTLING           HANDLING LIVESTOCK WASTE  KEYWORDS  TREATMENT OXIDATION-LAGOONS DISPOSAL DRYING SEPARAT
100 71 0573  SETTLING-BASIN     METHODS OF REMOVING SETTLEABLE SOLIDS FROM OUTDOOR BEEF CATTLE FEEDLOT RUNOFF  KEYWORDS
200 71 0703  SETTLING-BASIN     FEEDLOT WASTE MANAGEMENT  SOME SOLUTIONS TO THE PROBLEM  KEYWORDS  MOISTURE-CONTENT SAM
200 71 0803  SETTLING-BASIN     MANURE MANAGEMENT IN A 700 HEAD SWINE FINISHING BUILDING  TWO APPROACHES USING RENOVATE
300 69 0735  SETTLING-BASIN     SECONDARY TREATMENT OF HOG WASTE IN AN ANAEROBIC STABILIZATION POND  KEYWORD  SETTLING-
300 71 0700  SETTLING-BASIN     LIVESTOCK WASTE DISPOSAL AND WATER POLLUTION CONTROL  KEYWORD  FEED-LOTS CATTLE RUNOFF
200 71 0666  SETTLING-BASINS    PERFORMANCE OF DUCK WASTEWATER TREATMENT FACILITIES  KEYWORDS  DUCK OXIDATION-LAGOONS S
300 67 1253  SETTLING-BASINS    WATER QUALITY CHANGES IN CONFINED HOG WASTE TREATMENT KEYWORDS FARM-WASTES WASTE-TREATM
400 71 1174  SETTLING-BASINS    LIQUID WASTE SEEPS FROM ONE BASIN TO ANOTHER KEYWORDS AQUIFER CATTLE FARM-WASTES FEED-L
400 72 1179  SETTLING-BASINS    THE PRICE TAG TO STOP FEEDLOT RUN OFF KEYWORDS FARM-WASTE WASTE-DISPOSAL FEED-LOTS SETT
100 69 0035  SETTLING-TANK      TREATMENT OF BEEF-CATTLE WASTE WATER FOR POSSIBLE REUSE KEYWORDS  BOD COD PH SEPTIC-TAN
100 64 0345  SEWAGE             BOVINE-SALMONELLOSIS ASSOCIATED WITH CONTAMINATED CREEK-WATER AND HUMAN-INFECTION  KEYW
100 66 0063  SEWAGE             SOIL POLLUTANTS  THEIR ORIGIN AND BEHAVIOR  KEYWORDS  PESTICIDES SEWAGE DEGRADATION RAD
100 70 1037  SEWAGE             NITROGEN IN AGRICULTURE  THE PROBLEMS AND THE EFFECT ON THE ENVIRONMENT KEYWORDS
200 66 0140  SEWAGE             DEWATERING CHICKEN MANURES BY VACUUM FILTRATION  KEYWORDS DEWATERING VACUUM SEWAGE SLUD
200 70 0241  SEWAGE             SEWERS AND SEWAGE TREATMENT  KEYWORDS  LEGISLATION DESIGN-CRITERIA ACTIVATED-SLUDGE CAP
200 70 0321  SEWAGE             WASTE-DISPOSAL AND POLLUTION, POULTRY-PROCESSING  KEYWORDS  RENDERING-PLANT ODORS SEWAG
200 71 0811  SEWAGE             BOD ANALYSIS OF SWINE WASTE AS AFFECTED BY FEED ADDITIVES  KEYWORDS  COPPER ZINC ANTIBI
200 71 1099  SEWAGE             SUMMER CONFERENCE OF SOCIETY FOR APPLIED BACTERIOLOGY KEYWORDS MICROORGANISMS WATER-POL
300 53 1206  SEWAGE             POLLUTION OF STREAMS KEYWORDS DELAWARE WATER-POLLUTION STREAMS SOURCES
300 69 1103  SEWAGE             ENFORCEMENT OF WATER POLLUTION LAWS IN OKLAHOMA KEYWORDS OKLAHOMA WATER-POLLUTION-SOURC
300 72 1070  SEWAGE             PERIODICITY OF THE BLUE-GREEN ALGAE AND THEIR EFFECT ON THE EFFICIENCY OF MANURE-DISPOS
500 70 0390  SEWAGE             SIGNIFICANCE OF PHOSPHORUS IN WATER-SUPPLIES  KEYWORDS NUTRIENTS FERTILIZER DETERGENTS
500 71 1072  SEWAGE             HUMAN AND ANIMAL WASTES AS FERTILIZERS KEYWORDS FARM-WASTES SEWAGE WASTE-DISPOSAL IRRIG
700 70 1046  SEWAGE-ASSESSMENTS AN ECONOMIC ANALYSIS OF POULTRY PROCESSING WASTEWATER IN DELAWARE AND APPROPRIATE MUNIC
100 70 1217  SEWAGE-BACTERIA    APPLYING BACTERIOLOGICAL PARAMETERS TO RECREATIONAL WATER QUALITY  KEYWORDS REACREATION
200 70 1053  SEWAGE-BACTERIA    BACTERIOLOGICAL WATER QUALITY ANALYSES OF METHODS FOR DETECTING FECAL POLLUTION KEYWORD
200 71 0857  SEWAGE-DISPOSAL    NITROGEN REMOVAL FROM SEWAGE WATERS BY PLANTS AND SOIL  KEYWORD  FARM-WASTES SOIL-FILTE
300 69 1060  SEWAGE-DISPOSAL    FOULING OF WATERS A MISDEMEANOR KEYWORDS NORTH-DAKOTA SOURCES WATER-POLLUTION-CONTROL
300 69 1203  SEWAGE-DISPOSAL    FOULING OF WATERS A MISDEMEANOR KEYWORDS NORTH-DAKOTA SOURCES WATER-POLLUTION
400 68 0033  SEWAGE-DISPOSAL    IRRIGATING WITH ANIMAL WASTE  KEYWORDS  SPRINKLER-IRRIGATION SEWAGE-DISPOSAL EFFLUENT H
700 71 1120  SEWAGE-DISPOSAL    SOURCES OF PHOSPHATE AMMONIUM AND NITRATE CONTAMINATION IN  SOME CENTRAL NEW JERSEY STR
700 70 1046  SEWAGE-DISTRICTS   AN ECONOMIC ANALYSIS OF POULTRY PROCESSING WASTEWATER IN DELAWARE AND APPROPRIATE MUNIC
100 71 0722  SEWAGE-EFFLUENTS   THE USE OF FLUORESCENT ANTIBODY TECHNIQUES FOR DETECTION OF STREPTOCOCCUS FAECALIS AS A
100 72 1193  SEWAGE-EFFLUENTS   CHARACTERISTICS OF MILKING CENTER WASTE EFFLUENT FROM NEW YORK STATE DAIRY FARMS KEYWOR
300 46 1208  SEWAGE-EFFLUENTS   GREEN V MCCLOUD ACTION TO ENJOIN SEWAGE FLOW KEYWORDS KENTUCKY DOMESTIC-WASTES WATER-PO
300 69 1060  SEWAGE-EFFLUENTS   FOULING OF WATERS A MISDEMEANOR KEYWORDS NORTH-DAKOTA SOURCES WATER-POLLUTION-CONTROL
300 69 1203  SEWAGE-EFFLUENTS   FOULING OF WATERS A MISDEMEANOR KEYWORDS NORTH-DAKOTA SOURCES WATER-POLLUTION
400 67 1226  SEWAGE-EFFLUENTS   PHOSPHORUS & WATER POLLUTION KEYWORDS PHOSPHORUS GROUNDWATER WATER-POLLUTION-SOURCES SE
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400 73 1178	VENTILATION	ODOR CONTROL MAY BE A BIG CONCERN KEYWORDS ODOR LIVESTOCK FARM-WASTES DAIRY-INDUSTRY CO
600 71 0494	VENTILATION	A MODEL STUDY TO DETERMINE THE EFFCTS OF VENTILATION SYSTEMS UPON NH3 CONCENTRATIONS IN
600 72 1151	VENTILATION	IMPROVED BEEF CONFINEMENT FACILITIES THROUGH PIT VENTILATION AND TEMPERED AIR INTAKES K
600 71 0494	VENTILATION-SYSTEM	A MODEL STUDY TO DETERMINE THE EFFCTS OF VENTILATION SYSTEMS UPON NH3 CONCENTRATIONS IN
300 70 0385	VETERINARY-DIAGONO	AIR POLLUTANTS AFFECTING THE PERFORMANCE OF DOMESTIC ANIMALS - A LITERATURE REVIEW KEYW
300 71 1238	VIBRATING-SCREEN	CLOSED SYSTEM WASTE MANAGEMENT FOR LIVESTOCK KEYWORDS VIBRATING-SCREEN HYDRAULIC-TRANSP
200 69 1102	VIRAL-REMOVAL	MICROBIOLOGY OF A WASTE STABILIZATION POND KEYWORDS BIOLOGICAL-TREATMENT MICROBIOLOGY O
200 71 0602	VIRGINIA	STATE OF VIRGINIA ACTIVITIES IN ANIMAL WASTE MANAGEMENT KEYWORDS RUNOFF LAWS FEEDLOT V
200 71 0617	VIRGINIA	THE ROLE OF EXTENSION IN POLLUTION ABATEMENT IN VIRGINIA KEYWORDS POULTRY ADMINISTRAT
100 71 0307	VIRUS	ISOLATION OF GRANULOSIS VIRUS FROM HELIOTHIS-ARMIGERA AND ITS PERISTENCE IN AVIAN FECES
500 70 0402	VIRUS	DISEASE TRANSMISSION OF WATER-BORN ORGANISMS OF ANIMAL ORIGIN KEYWORDS PATHOLOGY WATE
100 71 0742	VIRUSES	INFECTIONS PANCREATIC NECROSIS VIRUS COMPARATIVE FREQUENCIES OF ISOLATION FROM FECES A
200 68 1242	VIRUSES	THE MOVEMENT OF DISEASE PRODUCING ORGANISMS THROUGH SOILS KEYWORDS WATER-REUSE PATHOGEN
200 68 1244	VIRUSES	SURVIVAL OF PATHOGENS AND RELATED DISEASE HAZARDS KEYWORDS HAZARDS IRRIGATION-WATER REC
200 69 1102	VIRUSES	MICROBIOLOGY OF A WASTE STABILIZATION POND KEYWORDS BIOLCGICAL-TREATMENT MICROBIOLOGY O
200 71 0812	VIRUSES	PORCINE ENTEROVIRUS SURVIVAL AND ANAEROBIC SLUDGE DIGESTION KEYWORDS VIRUSES SWINE SLU
600 72 1151	VIRUS-PNEUMONIA-IN	IMPROVED BEEF CONFINEMENT FACILITIES THROUGH PIT VENTILATION AND TEMPERED AIR INTAKES K
600 70 0080	VISCOMETERS	FLOW PROPERTIES OF ANIMAL WASTE SLURRIES KEYWORDS VISCOSITY FLOW-CHARACTERISTICS SHEA
600 70 0080	VISCOSITY	FLOW PROPERTIES OF ANIMAL WASTE SLURRIES KEYWORDS VISCOSITY FLOW-CHARACTERISTICS SHEA
100 71 0261	VOLATILE	ANAEROBIC DIGESTION OF FARM ANIMAL WASTES DAIRY BULL, SWINE,AND POULTRY KEYWORDS SLUD
200 66 0134	VOLATILE	OPERATING CHARACTERISTICS OF TWO AEROBIC-ANAEROBIC DAIRY MANURE TREATMENT SYSTEMS KEYW
200 66 0138	VOLATILE	DESIGN CRITERIA FOR ANAEROBIC LAGOONS FOR SWINE MANURE DISPOSAL KEYWORDS COD BOD TEMP
100 69 0363	VOLATILEODOR-TRANS	ODOR-TRANSPORT BY PARTICULATE-MATTER IN HIGH DENSITY POULTRY-HOUSES KEYWORDS GAS-CHROM
600 72 1004	VOLATILE-ORGANIC-A	CORRELATING OIL AND ODOROUS COMPONENTS IN STORED DAIRY MANURE KEYWORDS
200 66 0135	VOLATILE-SOLIDS	TRICKLING FILTERS AS A DAIRY-MANURE STABILIZATION COMPONENT KEYWORDS BOD LABORATORY TE
200 69 0168	VOLATILE-SOLIDS	AEROBIC DIGESTION OF DILUTED ANIMAL MANURE IN CLOSED SYSTEMS-TEMPORARY EXPEDIENT OR LON
200 69 0193	VOLATILE-SOLIDS	CHARACTERISTICS OF AQUEOUS SOLUTION OF CATTLE MANURE KEYWORDS BOD PH REDOX-POTENTIAL
600 69 1160	VOLATILE-SOLIDS	CHARACTERISTICS OF CATTLE FEEDLOT SURFACE RUNOFF KEYWORDS FEED-LOTS SURFACE-RUNOFF DISS
100 69 0103	VOLATILITY	NITROGEN ENRICHMENT OF SURFACE WATER BY ABSORPTION OF AMMONIA VOLATILIZED FROM CATTLE F
400 73 1178	VOLATILITY	ODOR CONTROL MAY BE A BIG CONCERN KEYWORDS ODOR LIVESTOCK FARM-WASTES DAIRY-INDUSTRY CO
600 72 1156	VOLATILITY	SEEPAGE LOSSES AND FERTILIZER PRESERVATION IN MANURE STACKING PRACTICE KEYWORDS
600 73 1075	VOLATILITY	THE EFFECT OF RATION ON ENGINEERING PROPERTIES OF BEEF CATTLE MANURE KEYWORDS
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100 65 0066	VOLUME	THE EFFECTS OF VOLUME AND SURFACE-AREA ON THE RATE OF ACCUMULATION OF SOLIDS IN INDOOR
100 69 0363	VOLUME	ODOR-TRANSPORT BY PARTICULATE-MATTER IN HIGH DENSITY POULTRY-HOUSES KEYWORDS GAS-CHROM
200 69 0197	VOLUME	REMOVAL OF WATER FROM ANIMAL MANURES KEYWORDS POULTRY ODOR MOISTURE-CONTENT WEIGHT VO
300 69 0006	VOLUME	SWINE WASTE MANAGEMENT-OXIDATION DITCH FOR TREATING HOG WASTES-FACT SHEET KEYWORDS DE
400 64 0358	VOLUME	TREATMENT OF FARM-EFFLUENTS KEYWORDS DAIRY HOGS BOD VOLUME WASTE-WATER SURFACE-WATER
400 65 0332	VOLUME	HOW WE HANDLE LIQUID-MANURE KEYWORDS DAIRY-CATTLE SLURRY STORAGE-TANKS AGITATION VOL
400 66 0380	VOLUME	TWO BILLION TONS OF - WHAT KEYWORDS ORGANIC-WASTES VOLUME ORGANIC-MATTER GRASS-BELTS P
400 68 0101	VOLUME	MANURE MANAGEMENT - COSTS AND PRODUCT FORMS KEYWORDS CATTLE MARKETING VOLUME PROFIT PR

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600 73 1075  VOLUMETRIC-ANALYSI THE EFFECT OF RATION ON ENGINEERING PROPERTIES OF BEEF CATTLE MANURE KEYWORDS
200 72 1018  VOLUNTARY-WASTE-CO EDUCATION ACTION AND REGULATORY PROBLEMS OF ANIMAL WASTE MANAGEMENT KEYWORDS
100 68 0087  VS                 AEROBIC-DIGESTION OF CATTLE-WASTE  KEYWORDS BOD COD VS FS AERATION LOADING-RATES REGRES
200 66 0121  VS                 PHYSICAL PROPERTIES OF ANIMAL MANURES ASSOCIATED WITH HANDLING  KEYWORDS  PHYSICAL-PROP
700 70 0231  VS                 THE INFLUENCE OF FEED ADDITIVES ON THE BIOCHEMICAL OXYGEN DEMAND ANALYSIS FOR SWINE WAS
100 63 1064  V-C-13             TOXICITY TO HOUSE FLIES AND HORN FLIES OF MANURE FROM INSECTICIDE FED CATTLE KEYWORDS
100 70 1111  WADING-BIRDS       POLYCHLORINATED BIPHENYLS KEYWORDS CHLORINATED-HYDROCARBON-PESTICIDES FOOD-CHAINS PESTI
300 71 1119  WALDORF-AERATOR    TREATMENT OF AQUEOUS AGRICULTURAL WASTES FOR CLEAN WATER AND FOR MICROBIAL PROTEIN PROD
200 69 0194  WARBURG            TYPICAL VARIATIONS ENCOUNTERED IN THE MEASUREMENT OF OXYGEN DEMAND OF ANIMAL WASTES  KE
400 71 1131  WARM-BARN          FIVE FEEDING SYSTEMS COMPARED KEYWORDS FEED-LOTS PERFORMANCE RUNOFF FARM-WASTES CATTLE
200 72 1017  WARM-SLOT-HOUSING  WASTE MANAGEMENT AND ANIMAL PERFORMANCE KEYWORDS FEED-LOTS FARM-WASTES WASTE-TREATMENT
200 71 0860  WASHING            DEWATERING POULTRY MANURE BY CENTRIFUGATION  KEYWORD  CENTRIFUGATION DEWATERING POULTRY
100 71 1236  WASHINGTON         MIGRATION OF POLLUTANTS IN A GLACIAL OUTWASH ENVIRONMENT KEYWORDS PATH-OF-POLLUTANTS GL
100 70 1237  WASHINGTON         POLLUTION POTENTIAL OF SALMONID FISH HATCHERIES KEYWORDS SOURCES FISH-HATCHERIES SALMON
100 65 0263  WASTE              REMOVAL OF PLANT NUTRIENTS BY MEANS OF AEROBIC STABILIZATION OF SLUDGE  KEYWORDS WASTE
100 66 0478  WASTE              LABORATORY STUDIES OF AEROBIC STABILIZATION OF SWINE WASTE  KEYWORDS  FARMWASTES WASTE
100 68 0481  WASTE              RETURNING WASTES TO THE LAND, A NEW ROLE FOR AGRICULTURE  KEYWORDS  WATER REUSE WASTE W
100 69 0416  WASTE              A STUDY OF SOME DISEASE HAZARDS WHICH COULD BE ASSOCIATED WITH THE SYSTEM OF APPLYING C
100 70 0260  WASTE              GROWTH OF MICROORGANISMS IN FRESH CHICKEN MANURE UNDER AEROBIC AND ANAEROBIC CONDITIONS
100 70 0420  WASTE              SOME EFFECTS OF ORGANIC WASTES ON AQUATIC INSECTS IN IMPOUNDED HABITATS  KEYWORDS  LAGO
100 70 1195  WASTE              AGRICULTURAL POLLUTION OF WATER BODIES KEYWORDS WATER-POLLUTION FARMS LIVESTOCK PHOSPHO
200 66 0438  WASTE              SOIL CHEMICAL CHANGES AND INFILTRATION RATE REDUCTION UNDER SEWAGE SPREADING  KEYWORDS
300 69 0633  WASTE              THE QUANTITATIVE DETERMINATION OF THE ODOR STRENGTH OF CHICKEN MANURE  KEYWORDS  WASTE
400 69 0419  WASTE              DIGESTION OF POULTRY MANURE BY DIPTERA  KEYWORDS  WASTE TREATMENT WASTE DISPOSAL FARM W
400 69 0419  WASTE              DIGESTION OF POULTRY MANURE BY DIPTERA  KEYWORDS  WASTE TREATMENT WASTE DISPOSAL FARM W
400 70 0268  WASTE              MANURE STACKING  KEYWORDS  WASTE DUMPS WASTE-DISPOSAL UITIMATE-DISPOSAL WASTE-STORAGE F
400 71 0267  WASTE              WASTE MANAGEMENT WHAT DOES IT COST  KEYWORDS  WASTE DISPOSAL COSTS COST ANALYSIS COST F
400 71 0327  WASTE              RECYCLED POULTRY NUTRIENTS  KEYWORDS  FARM-WASTES POULTRY WASTE-DISPOSAL DRIED-POULTRY
400 71 0329  WASTE              DISPOSAL OF HATCHERY WASTES  KEYWORDS  POULTRY INCINERATION WASTE TREATMENT DISPOSAL HA
400 71 0435  WASTE              THE MOUNTING PROBLEM OF CATTLE FEEDLOT POLLUTION  KEYWORDS  WASTE-DISPOSAL AIR-POLLUTIO
100 71 0751  WASTELAGE          ANIMAL WASTE VALUE-NUTRIENT RECOVERY AND UTILIZATION  KEYWORDS  POULTRY SWINE CATTLE PA
200 69 0171  WASTELAGE          CATTLE MANURE- REUSE THROUGH WASTELAGE FEEDING  KEYWORDS  FEEDS PERFORMANCES WASTELAGE
200 71 0845  WASTELAGE          CATTLE MANURE AS FEED FOR CATTLE  KEYWORD  RECYCLING ANIMAL-PATHOLOGY MICROORGANISMS NE
100 63 0436  WASTES             POULTRY DUST  ORIGIN AND COMPOSITION  KEYWORDS  FARM WASTES POULTRY ENVIRONMENTAL EFFEC
100 64 0474  WASTES             PROPERTIES AND PUMPING CHARACTERISTICS OF HOG WASTES KEYWORDS  SOLIDS N DIAPHRAGM-PUMP
100 65 1219  WASTES             NITRATES IN THE ENVIROMENT KEYWORDS NITROGEN  ATMOSPHERE BIOSPHERE FERTILIZATION NITROG
100 66 0437  WASTES             PROPERTIES OF FARM ANIMAL EXCRETA  KEYWORDS  LIVESTOCK GASES BIODEGRADATION BIOCHEMICAL
100 66 0473  WASTES             BOD OF CAPTIVE WILD ANIMAL WASTES  KEYWORDS  ZOO TOTAL-SCLID BOD WASTES
100 68 0306  WASTES             ANAEROBIC DIGESTION FAILURES  KEYWORDS DIGESTION SLUDGE DISPOSAL AMMONIUM ALKALINE BUIL
100 68 0381  WASTES             WASTES FROM PIG-PRODUCTION UNITS  KEYWORDS  OXIDATION-DITCH EFFLUENT BOD LININGS SECOND
100 70 0413  WASTES             VALUE OF PROCESSED POULTRY WASTE AS A FEED FOR RUMINANTS  KEYWORDS  WASTE-TREATMENT DIG
100 70 0418  WASTES             ENRICHMENT OF CATTLE MANURE FOR FEED BY ANAEROBIC FERMENTATION  KEYWORDS  FARM WASTES T
100 71 0569  WASTES             ENZYMATIC EVALUATION OF PROCESSES FOR IMPROVING AGRICULTURAL WASTES FOR RUMINANT FEEDS
200 66 0140  WASTES             DEWATERING CHICKEN MANURES BY VACUUM FILTRATION  KEYWORDS DEWATERING VACUUM SEWAGE SLUD
200 67 1243  WASTES             THE IMPACT OF ANIMAL WASTES ON WATER RESOURCES ACTIVITIES KEYWORDS ANIMAL-WASTES WASTES
200 70 1118  WASTES             WATER QUALITY MANAGEMENT PROBLEMS IN ARID REGIONS KEYWORDS CONFERENCES WATER-QUALITY SO
200 71 0665  WASTES             WASTE MANAGEMENT ON A MODERN DAIRY FARM  KEYWORDS  CATTLE SOIL-DISPOSAL-FIELDS SEPTIC-T
200 71 1099  WASTES             SUMMER CONFERENCE OF SOCIETY FOR APPLIED BACTERIOLOGY KEYWORDS MICROORGANISMS WATER-POL
300 53 1206  WASTES             POLLUTION OF STREAMS KEYWORDS DELAWARE WATER-POLLUTION STREAMS SOURCES
300 68 1122  WASTES             NITROGEN CYCLE IN SURFACE AND SUBSURFACE WATERS KEYWORDS DOMESTIC-ANIMALS WASTES FERTIL
300 69 1060  WASTES             FOULING OF WATERS A MISDEMEANOR KEYWORDS NORTH-DAKOTA SOURCES WATER-POLLUTION-CONTROL
300 69 1125  WASTES             ANIMAL WASTE DISPOSAL PROBLEMS AND TRENDS IN MINNESOTA KEYWORDS LIVESTOCK WASTES FARM-W
300 69 1203  WASTES             FOULING OF WATERS A MISDEMEANOR KEYWORDS NORTH-DAKOTA SOURCES WATER-POLLUTION
300 70 1248  WASTES             LIVESTOCK INDUSTRIES IN TEXAS AS RELATED TO WATER QUALITY REPORT NUMBER ONE KEYWORDS
400 69 0419  WASTES             DIGESTION OF POULTRY MANURE BY DIPTERA  KEYWORDS  WASTE TREATMENT WASTE DISPOSAL FARM W
400 71 1135  WASTES             ENGINEER SAYS FEEDERS CAN HANDLE MOST POLLUTION CONTROL PRACTICES KEYWORDS
300 72 1085  WASTES-CHARACTERIS CHARACTERISTICS OF RAINFALL RUNOFF FROM A BEEF CATTLE FEEDLOT KEYWORDS
100 72 1188  WASTES-GASES       IDENTIFICATION OF BEEF CATTLE FEEDLOT ODORS KEYWORDS AIR-POLLUTION ODOR CATTLE FEED-LOT
300 69 1125  WASTES-MANAGEMENT  ANIMAL WASTE DISPOSAL PROBLEMS AND TRENDS IN MINNESOTA KEYWORDS LIVESTOCK WASTES FARM-W
300 71 0744  WASTEWATER         ANIMAL SLAUGHTERING AND PROCESSING  KEYWORDS  REGULATIONS BY-PRODUCTS SOLID-WASTES INDU
200 70 0747  WASTEWATER-DISPOSA ALTERNATIVES IN CATTLE FEEDLOT WASTE MANAGEMENT  KEYWORD  WASTE-TREATMENT DESIGN-CRITER
700 72 1048  WASTEWATER-DISPOSA SPRINKLER APPLICATION OF ANAEROBICALLY TREATED SWINE WASTES AS LIMITED BY NITROGEN CONC
200 70 0670  WASTEWATER-TREATME ALTERNATIVES FOR THE TREATMENT AND DISPOSAL OF ANIMAL WASTES  KEYWORDS  FARM-WASTES CON
200 70 0747  WASTEWATER-TREATME ALTERNATIVES IN CATTLE FEEDLOT WASTE MANAGEMENT  KEYWORD  WASTE-TREATMENT DESIGN-CRITER
300 70 0489  WASTEWATER-TREATME WATER-QUALITY REQUIREMENTS AND RE-USE OF WASTEWATER EFFLUENTS  KEYWORDS  NUTRIENT-REMOV
700 72 1048  WASTEWATER-TREATME SPRINKLER APPLICATION OF ANAEROBICALLY TREATED SWINE WASTES AS LIMITED BY NITROGEN CONC
200 71 0835  WASTE-ASSIMILATIVE AEROBIC STORAGE OF POULTRY MANURE  KEYWORD  AERATION AEROBIC-CONDITIONS WASTE-ASSIMILAT
300 70 1036  WASTE-ASSIMILATIVE AGRICULTURE  THE UNSEEN FOE IN THE WAR ON POLLUTION KEYWORDS AGRICULTURE WATER-POLLUTIO
200 71 0660  WASTE-BYPRODUCTS   UTILIZATION OF AGRICULTURAL WASTES  KEYWORDS  WASTE-BYPRODUCTS ARTIFICAL-USE WASTE-DISP
100 68 1229  WASTE-CHARACTERIST ANAEROBIC LAGOON TREATMENT OF MILKING PARLOR WASTES KEYWORDS ANAEROBIC-CONDITIONS INDUS
200 71 0709  WASTE-DILUTION     BEEF CATTLE FEEDLOT WASTE MANAGEMENT PROGRAM  KEYWORDS  RUN-OFF CATTLE WASTE-DILUTION R
300 70 1192  WASTE-DILUTIONS    IMPLICATIONS OF WATER QUALITY LAWS FOR THE FEEDLOT INDUSTRY KEYWORDS CONTROL POLLUTION-
100 62 1220  WASTE-DISPOSAL     WATER POLLUTION RESULTING FROM AGRICULTURAL ACTIVITIES KEYWORDS WATER-POLLUTION-SOURCES
100 71 0266  WASTE-DISPOSAL     CAGED LAYER PERFORMANCE IN PENS WITH OXIDATION DITCHES AND  LIQUID MANURE STORAGE TANKS
100 71 1214  WASTE-DISPOSAL     THE DISPOSAL OF AGRICULTURAL WASTE KEYWORDS WASTE-DISPOSAL FARM-WASTES WATER-POLLUTION
100 71 1228  WASTE-DISPOSAL     ALTERNATIVES FOR THE TREATMENT AND DISPOSAL OF ANIMAL WASTES  KEYWORDS FARM-WASTES DISP
100 73 1069  WASTE-DISPOSAL     MANURING OF POTATOES ON PEN SILT SOILS IN HOLLAND LINCCLNSHIRE KEYWORDS
100 73 1162  WASTE-DISPOSAL     PERSISTENCE OF MANURE PHCSPHORUS AVAILABILITY IN CALCARECUS SOIL KEYWORDS
100 73 1184  WASTE-DISPOSAL     ANIMAL WASTE MANAGEMENT IN HAWAII KEYWORDS FARM-WASTES LIVESTOCK WASTE-DISPOSAL WASTE-T
200 67 1243  WASTE-DISPOSAL     THE IMPACT OF ANIMAL WASTES ON WATER RESOURCES ACTIVITIES KEYWORDS ANIMAL-WASTES WASTES
200 69 0159  WASTE-DISPOSAL     ENVIRONMENTAL POLLUTION--NOW AND IN THE YEARS AHEAD  KEYWORDS  LEGAL-ASPECTS DESIGN-STA
200 69 0522  WASTE-DISPOSAL     FUTURE-TRENDS IN LIVESTOCK-PRODUCTION  KEYWORDS  WISCONSIN  WASTE-DISPOSAL DAIRY CATTLE
200 69 1116  WASTE-DISPOSAL     MANAGING LIVESTOCK WASTES TO CONTROL POLLUTION KEYWORDS POLLUTION-CONTROL ORGANIC-LOADI
200 69 1167  WASTE-DISPOSAL     AGRICULTURAL WASTES  A MANAGEMENT PROBLEM KEYWORDS POLLUTION WASTE-DISPOSAL AGRICULTURA
200 69 1185  WASTE-DISPOSAL     ECONOMICS OF WATER POLLUTION CONTROL KEYWORDS POLLUTION WATER-POLLUTION ECONOMICS HERBI
200 70 0720  WASTE-DISPOSAL     PROGRESS REPORT  PASTURE FERTILIZATION USING POULTRY LITTER  KEYWORDS FARM-WASTE WASTE-
200 70 0755  WASTE-DISPOSAL     FEEDLOT WASTE IN FLORIDA  KEYWORD  WASTE-TREATMENT BIOLOGICAL-TREATMENT WASTE-DISPOSAL
200 70 1159  WASTE-DISPOSAL     METHODS OF SWINE MANURE DISPOSAL KEYWORDS FARM-WASTES MANAGEMENT WASTE-DISPOSAL HOGS LA
200 70 1175  WASTE-DISPOSAL     ANIMAL WASTE DISPOSAL KEYWORDS WATER-LAW REGULATION PERMITS FEED-LOTS WASTE-DISPOSAL
200 71 0660  WASTE-DISPOSAL     UTILIZATION OF AGRICULTURAL WASTES  KEYWORDS  WASTE-BYPRODUCTS ARTIFICAL-USE WASTE-DISP
200 71 0664  WASTE-DISPOSAL     ADVISORY GROUPS FOR ENVIRONMENTAL PROTECTION AND AGRICULTURAL COOPERATION  KEYWORDS  RE
200 71 0733  WASTE-DISPOSAL     ALTERNATIVES FOR WASTE MANAGEMENT FOR OPEN BEEF FEEDLOTS  KEYWORD  RUNOFF SOLID-WASTES
200 71 0763  WASTE-DISPOSAL     ANIMAL WASTES AND AMERICA THE BEAUTIFUL KEYWORDS FARM-WASTES CONFINEMENT-PENS ODORS NUT
200 71 0769  WASTE-DISPOSAL     A COMPUTER MODEL FOR STORAGE AND LAND DISPOSAL OF ANIMAL WASTES  KEYWORDS  COMPUTER-MOD
200 71 0779  WASTE-DISPOSAL     EVALUATION OF BEEF FEEDLOT WASTE MANAGEMENT ALTERNATIVES KEYWORDS FARM-WASTES WASTE-TRE
200 71 0834  WASTE-DISPOSAL     SUBSURFACE DISPOSAL OF LIQUID MANURE  KEYWORD  WASTE-DISPOSAL FERTILIZATION WASTE-STORA
200 71 1094  WASTE-DISPOSAL     AGRICULTURE AND POLLUTION--SOCIO-ECONOMIC ASPECTS KEYWORDS WATER-POLLUTION ECONOMICS SU
200 71 1096  WASTE-DISPOSAL     ENGINEERING AGRICULTURAL WASTES KEYWORDS DEHYDRATION LAND-USE PROTEINS EROSION TECHNOLO
200 72 1010  WASTE-DISPOSAL     PROCEEDINGS  LIVESTOCK WASTE MANAGEMENT RESEARCH REVIEW KEYWORDS LIVESTOCK FARM-WASTES
200 72 1011  WASTE-DISPOSAL     NATIONAL LIVESTOCK WASTE MANAGEMENT PROGRAM KEYWORDS FARM-WASTE FEED-LOTS GROUNDWATER R
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200 72 1012  WASTE-DISPOSAL       REGIONAL LIVESTOCK WASTE MANAGEMENT PROGRAM KEYWORDS RESEARCH-AND-DEVELOPMENT LIVESTOCK
200 72 1014  WASTE-DISPOSAL       APPLICATION UTILIZATION AND DISPOSAL OF LIVESTOCK WASTE KEYWORDS WASTE-DISPOSAL WASTE-T
200 72 1016  WASTE-DISPOSAL       CHARACTERISTICS OF ANIMAL WASTES AND RUNOFF KEYWORDS CONDUCTIVITY FARM-WASTES RUNOFF TH
200 72 1018  WASTE-DISPOSAL       EDUCATION ACTION AND REGULATORY PROBLEMS OF ANIMAL WASTE MANAGEMENT KEYWORDS
200 72 1020  WASTE-DISPOSAL       POLLUTION OF AIR WATER AND SOIL BY LIVESTOCK KEYWORDS AIR-POLLUTION WATER-POLLUTION SOI
200 72 1021  WASTE-DISPOSAL       APPLICATION UTILIZATION AND DISPOSAL OF LIVESTOCK WASTES KEYWORDS FARM-WASTES FEED-LOTS
200 72 1022  WASTE-DISPOSAL       RESEARCH NEEDS FOR THE DESIGN AND MANAGEMENT OF BEEF FEEDLOT RUNOFF-CONTROL SYSTEMS KEY
200 72 1023  WASTE-DISPOSAL       CHARACTERISTICS OF LIVESTOCK WASTE AND RUNOFF KEYWORDS FARM-WASTES PHYSICAL-PROPERTIES
200 72 1024  WASTE-DISPOSAL       WASTE-INDUCED PROBLEMS OF HOUSED LIVESTOCK KEYWORDS LIVESTOCK SHEEP CATTLE HOGS NEBRASK
200 72 1025  WASTE-DISPOSAL       OTHER RESEARCH NEEDS KEYWORDS FARM-WASTES PROTEINS RUNOFF FEED-LOTS WASTE-DISPOSAL
200 72 1029  WASTE-DISPOSAL       CONCLUDING COMMENTS KEYWORDS FARM-WASTES CROP-PRODUCTION LIVESTOCK SOILS MARKETING  WAS
200 72 1030  WASTE-DISPOSAL       RECOVERY OF ANIMAL FEED FROM CATTLE MANURE KEYWORDS RECYCLING FARM-WASTES CATTLE FEED-L
200 73 1062  WASTE-DISPOSAL       CONTINUED RECYCLING OF CATTLE MANURE KEYWORDS CATTLE FARM-WASTES RECYCLING NITROGEN CAL
200 73 1082  WASTE-DISPOSAL       COSTS FOR LARGE SCALE CONTINUOUS PYROLYSIS OF SOLID WASTES  KEYWORDS SOLID-WASTES COSTS
200 73 1083  WASTE-DISPOSAL       CONTINUOUS SOLID WASTE RETORT-FEASIBILITY STUDY KEYWORDS CATTLE FARM-WASTES WASTE-DISPO
200 73 1189  WASTE-DISPOSAL       A FEEDER LOOKS AT ANIMAL WASTE DISPOSAL KEYWORDS FARM-WASTES WASTE-DISPOSAL FEED-LOTS F
300    1077  WASTE-DISPOSAL       SOIL CONDITIONS UNDER FEEDLOTS AND ON LAND TREATED WITH LARGE AMOUNTS OF ANIMAL WASTES
300    1105  WASTE-DISPOSAL       RULE AND REGULATION FOR THE REGISTRATION OF FEEDLOTS KEYWORDS NEBRASKA WATER-POLLUTION-
300 26 1204  WASTE-DISPOSAL       OHIO STOCK FOOD COMPANY V GINTLING STREAM POLLUTION BY UPPER RIPARIAN HOG FARM KEYWORDS
300 62 0754  WASTE-DISPOSAL       NOTES ON WATER POLLUTION  WASTE WATERS FROM FARMS  KEYWORDS  FARM-WASTES IRRIGATION BOD
300 67 1249  WASTE-DISPOSAL       AGRICULTURAL AND RELATED WASTES CONTROL KEYWORDS WASTE-DISPOSAL KANSAS DOMESTIC-ANIMALS
300 69 1061  WASTE-DISPOSAL       RULES FOR CONFINED FEEDING OPERATIONS WASTE WATER DISPOSAL  KEYWORDS IOWA FARM-WASTES L
300 69 1103  WASTE-DISPOSAL       ENFORCEMENT OF WATER POLLUTION LAWS IN OKLAHOMA KEYWORDS OKLAHOMA WATER-POLLUTION-SOURC
300 69 1180  WASTE-DISPOSAL       CATTLE FEEDLOT POLLUTION STUDY KEYWORDS CATTLE FEED-LOTS FARM-WASTES WASTE-DISPOSAL RUN
300 69 1203  WASTE-DISPOSAL       FOULING OF WATERS A MISDEMEANOR KEYWORDS NORTH-DAKOTA SOURCES WATER-POLLUTION
300 70 1000  WASTE-DISPOSAL       EQUIPMENT AND FACILITIES FOR MODERN METHODS OF SWINE MANURE DISPOSAL KEYWORDS
300 70 1036  WASTE-DISPOSAL       AGRICULTURE  THE UNSEEN FOE IN THE WAR ON POLLUTION KEYWORDS AGRICULTURE WATER-POLLUTIO
300 70 1192  WASTE-DISPOSAL       IMPLICATIONS OF WATER QUALITY LAWS FOR THE FEEDLOT INDUSTRY KEYWORDS CONTROL POLLUTION-
300 70 1247  WASTE-DISPOSAL       DISPOSAL OF INDUSTRIAL WASTES KEYWORDS OREGON INDUSTRIAL-WASTES WASTE-DISPOSAL POLLUTIO
300 70 1248  WASTE-DISPOSAL       LIVESTOCK INDUSTRIES IN TEXAS AS RELATED TO WATER QUALITY REPORT NUMBER ONE KEYWORDS
300 71 0697  WASTE-DISPOSAL       ROLE OF ANIMAL WASTES IN AGRICULTURAL LAND RUNOFF  KEYWORD  WATER-POLLUTION FARM-LAGOON
300 71 1008  WASTE-DISPOSAL       ANIMAL WASTE DISPOSAL AND CONTROL OF FEEDLOT RUNOFF KEYWORDS FEED-LOTS WASTE-DISPOSAL R
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300 69 1125  WATER-POLLUTION-SO ANIMAL WASTE DISPOSAL PROBLEMS AND TRENDS IN MINNESOTA KEYWORDS LIVESTOCK WASTES FARM-W
300 69 1180  WATER-POLLUTION    CATTLE FEEDLOT POLLUTION STUDY KEYWORDS CATTLE FEED-LOTS FARM-WASTES WASTE-DISPOSAL RUN
300 69 1203  WATER-POLLUTION-CO FOULING OF WATERS A MISDEMEANOR KEYWORDS NORTH-DAKOTA SOURCES WATER-POLLUTION
300 70 0205  WATER-POLLUTION    INTRODUCTION  KEYWORDS ODOR WATER-POLLUTION AIR-POLLUTION SOIL-CONTAMINATION INSECTS DI
300 70 0384  WATER-POLLUTION    THE ECONOMICS OF CLEAN WATER  VOLUME TWO  ANIMAL WASTES PROFILE KEYWORDS COSTS WATER-PO
300 70 1036  WATER-POLLUTION    AGRICULTURE  THE UNSEEN FOE IN THE WAR ON POLLUTION KEYWORDS AGRICULTURE WATER-POLLUTIO
300 70 1059  WATER-POLLUTION-SO NITRATE ACCUMULATION IN KANSAS GROUNDWATER KEYWORDS NITRATES GROUNDWATER FERTILIZATION
300 70 1192  WATER-POLLUTION-EF IMPLICATIONS OF WATER QUALITY LAWS FOR THE FEEDLOT INDUSTRY KEYWORDS CONTROL POLLUTION-
300 70 1201  WATER-POLLUTION    OKLAHOMA FEED YARDS ACT KEYWORDS OKLAHOMA WATER-POLLUTION CONTROL SURFACE
300 70 1247  WATER-POLLUTION    DISPOSAL OF INDUSTRIAL WASTES KEYWORDS OREGON INDUSTRIAL-WASTES WASTE-DISPOSAL POLLUTIO
300 71 0697  WATER-POLLUTION    ROLE OF ANIMAL WASTES IN AGRICULTURAL LAND RUNOFF  KEYWORD  WATER-POLLUTION FARM-LAGOON
300 71 1008  WATER-POLLUTION    ANIMAL WASTE DISPOSAL AND CONTROL OF FEEDLOT RUNOFF KEYWORDS FEED-LOTS WASTE-DISPOSAL R
300 71 1055  WATER-POLLUTION-CO ANNUAL REPORT OF ACTIVITIES DURING FISCAL YEAR 1971 KEYWORDS WATER-RESOURCES WATER-USER
300 71 1057  WATER-POLLUTION-EF EFFECTS OF POLLUTION ESPECIALLY FROM FEEDLOTS ON FISHES IN  THE UPPER NEOSHO RIVER BASI
300 71 1058  WATER-POLLUTION-SO DEVELOPMENT OF A MATHEMETICAL MODEL TO PREDICT THE ROLE OF  SURFACE RUNOFF AND GROUNDWA
300 71 1098  WATER-POLLUTION-CO BIBLIOGRAPHY OF PRODUCTS DERIVED FROM AQUATIC ORGANISMS KEYWORDS AQUATIC-PLANTS FISH PO
300 71 1100  WATER-POLLUTION-SO DETERMINATION ON MERCURY IN SAMPLES FROM THE DUTCH ENVIRONMENT  KEYWORDS MERCURY NEUTRO
300 71 1106  WATER-POLLUTION-CO MANAGING OUR ENVIRONMENT KEYWORDS MANAGEMENT ENVIRONMENT AGRICULTURE WATER-POLLUTION-CO
300 71 1107  WATER-POLLUTION-SO WATER POLLUTION CONTROL LEGISLATION AGRICULTURAL RUNOFF PART 6  KEYWORDS AGRICULTURAL-C
300 71 1126  WATER-POLLUTION-EF SAVANNAH RIVER ECOLOGY LABORATORY ANNUAL REPORT 1971 KEYWORDS BORON NUTRIENT-REQUIREMEN
300 71 1246  WATER-POLLUTION-CO FEEDLOT WASTE MANAGEMENT KEYWORDS WATER-POLLUTION-CONTROL CONFINEMENT-PENS CATTLE POLLU
300 72 1003  WATER-POLLUTION    CATTLE FEEDLOTS AND THE ENVIRONMENT KEYWORDS FEED-LOTS DESIGN-CRITERIA AIR-POLLUTION WA
300 72 1052  WATER-POLLUTION-SO EFFECT OF ANIMAL WASTES APPLIED TO SOILS ON SURFACE AND GROUNDWATER SYSTEMS KEYWORDS
300 73 1009  WATER-POLLUTION    STREAM POLLUTION FROM CATTLE FEEDLOT RUNOFF KEYWORDS WATER-POLLUTION CATTLE FARM-WASTES
400 65 1127  WATER-POLLUTION-SO WHY NITRATES IN WATER SUPPLIES KEYWORDS NITRATES FEED-LOTS FERTILIZERS FARM-WASTES MISS
400 65 1141  WATER-POLLUTION-SO NITRATES DANGER FOR HUMANS. TOO KEYWORDS FEED-LOTS WATER-WELLS NITRATES FARM-WASTES MIS
400 67 1226  WATER-POLLUTION-SO PHOSPHORUS & WATER POLLUTION KEYWORDS PHOSPHORUS GROUNDWATER WATER-POLLUTION-SOURCES SE
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400 69 1045  WATER-POLLUTION-SO  AGRICULTURES CONTRIBUTION TO THE FERTILIZATION OF CANAL LAKE KEYWORDS EUTROPHICATION NU
400 69 1225  WATER-POLLUTION     CONSERVING RESOURCES AND MAINTAINING A QUALITY ENVIRONMENT  KEYWORDS WATER-RESOURCE-DEV
400 70 0046  WATER-POLLUTION     FARM WASTE DISPOSAL - AMENITY AND GOOD NEIGHBOURLINESS KEYWORDS ODOR WATER-POLLUTION BU
400 70 1176  WATER-POLLUTION     ANIMAL WASTE DISPOSAL KEYWORDS ANIMAL-WASTES WASTE-DISPOSAL WATER-POLLUTION NITRATES
400 71 1137  WATER-POLLUTION-CO  REGISTRATION IS REQUIRED AS GOVERNMENT MOVES TO CONTROL WATER POLLUTION FROM LARGE FEED
400 71 1143  WATER-POLLUTION-CO  A LOVELY NEW SCENT FOR MANURE KEYWORDS AIR-POLLUTION SAGEBRUSH FARM-WASTES ODOR
400 71 1144  WATER-POLLUTION     CONFINEMENT FEEDING, PROS, CONS, AND TIPS KEYWORDS RUNOFF WATER-POLLUTION AIR-POLLUTION
400 71 1174  WATER-POLLUTION-CO  LIQUID WASTE SEEPS FROM ONE BASIN TO ANOTHER KEYWORDS AQUIFER CATTLE FARM-WASTES FEED-L
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400 73 1063  WATER-POLLUTION     AGRICULTURE AND ENVIRONMENT KEYWORDS PHOTOSYNTHESIS WATER-POLLUTION NITRATES PHOSPHATES
400 73 1158  WATER-POLLUTION-CO  DO YOU HAVE TO MOVE EM OR CAN YOU LEAVE EM KEYWORDS FEED-LOTS RUNOFF WASTE-STORAGE WAST
500 70 0388  WATER-POLLUTION     CHEMISTRY OF SEDIMENT IN WATER  KEYWORDS  NITROGEN PHOSPHORUS WATER-POLLUTION CLAYS ORG
500 70 0396  WATER-POLLUTION     THE PESTICIDE BURDEN IN WATER AND ITS SIGNIFICANCE  KEYWORDS  DDT SOURCES CONCENTRATION
500 70 0404  WATER-POLLUTION     MOVEMENT OF AGRICULTURAL-POLLUTANTS WITH GROUNDWATER  KEYWORDS WATER-POLLUTION ZONE-OF-
500 70 0408  WATER-POLLUTION     LEGAL-ASPECTS  KEYWORDS  WATER-POLLUTION PESTICIDES SILTING FERTILIZERS POINT-SOURCES N
500 70 0410  WATER-POLLUTION     ALLIANCE FOR ACTION  KEYWORDS  WATER-POLLUTION FEEDLOTS REGISTRATION INVENTORY WASTE-MA
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500 71 1255  WATER-POLLUTION-SO  DISEASES OF FEEDLOT CATTLE KEYWORDS ANIMAL-DISEASES CATTLE FEED-LOTS FARM-WASTES WATER-
600 69 1005  WATER-POLLUTION-CO  FACILITY DESIGN KEYWORDS FEED-LOTS RUNOFF WATER-POLLUTION-CONTROL DESIGN FARM-WASTES
600 73 1065  WATER-POLLUTION     EFFECTS OF SWINE LAGOON EFFLUENT OF THE SOIL AND PLANT TISSUE KEYWORDS
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700 72 1049  WATER-POLLUTION-SO  ECONOMICS OF WATER QUALITY MANAGEMENT  EXEMPLIFIED BY SPECIFIED POLLUTANTS IN AGRICULTU
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100 67 1218  WATER-QUALITY       FUTURE WATER QUALITY DESIGN KEYWORDS WATER-QUALITY WATER-POLLUTION WATER-QUALITY-MANAGE
100 67 1258  WATER-QUALITY       RECOVERY OF BACTERIAL PATHOGENS FROM HIGH QUALITY SURFACE WATER KEYWORDS
100 69 0375  WATER-QUALITY       RURAL-RUNOFF AS A FACTOR IN STREAM-POLLUTION  KEYWORDS WATER-QUALITY SOIL-EROSION COLIF
100 70 1217  WATER-QUALITY       APPLYING BACTERIOLOGICAL PARAMETERS TO RECREATIONAL WATER QUALITY  KEYWORDS REACREATION
100 71 0453  WATER-QUALITY       PLANT NUTRIENTS AND WATER QUALITY KEYWORDS  NUTRIENTS WATER-QUALITY
100 71 0484  WATER-QUALITY       RELATIONSHIPS OF SALMONELLA TO FECAL COLIFORMS IN BOTTOM SEDIMENTS  KEYWORD  INDICATORS
100 71 0681  WATER-QUALITY       EFFECT OF FEEDLOT LAGOON WATER ON SOME PHYSICAL AND CHEMICAL PROPERTIES OF SOILS  KEYWO
100 71 0722  WATER-QUALITY       THE USE OF FLUORESCENT ANTIBODY TECHNIQUES FOR DETECTION OF STREPTOCOCCUS FAECALIS AS A
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100 71 1212  WATER-QUALITY       EFFECTS OF MULTIPLE USE ON WATER QUALITY OF HIGH MOUNTAIN WATERSHEDS BACTERIOLOGICAL IN
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200 69 0158  WATER-QUALITY       REFLECTIONS ON POLLUTION CONTROL  KEYWORDS  WATER-QUALITY COST-BENEFIT-RATIO ENVIRONMEN
200 69 0423  WATER-QUALITY       2 ND COMPENDIUM OF ANIMAL WASTE MANAGEMENT KEYWORDS  RAINFALL-RUNOFF EQUIPMENT DESIGN-D
200 69 0426  WATER-QUALITY       REGULATORY ASPECTS OF FEEDLOT WASTE MANAGEMENT  KEYWORDS  LEGISLATION RUNOFF WATER-QUAL
200 69 0523  WATER-QUALITY       WHAT AND WHERE ARE THE CRITICAL-SITUATIONS WITH FARM ANIMAL-WASTES AND BY-PRODUCTS IN W
200 69 0708  WATER-QUALITY       TOTAL ORGANIC CARBON DETERMINATIONS ON SWINE WASTE EFFLUENTS  KEYWORDS  BOD COD TEST-PR
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200 71 0483  WATER-QUALITY       HOW CAN PORK-PRODUCERS COMPLY WITH ENVIRONMENTAL QUALITY-STANDARDS  KEYWORDS  WATER-QUA
200 71 0642  WATER-QUALITY       AGRICULTURAL WASTES  PRINCIPLES AND GUIDELINES FOR PRACTICALSOLUTIONS  KEYWORDS  WATER-
200 71 0644  WATER-QUALITY       ENVIRONMENTAL QUALITY AND PRODUCTIVITY  KEYWORDS  WATER-QUALITY WATER-POLLUTION
200 71 0650  WATER-QUALITY       GUIDELINES FOR MINIMIZING PESTICIDE POLLUTION  KEYWORDS PESTICIDE-DRIFT WATER-QUALITY P
200 71 0774  WATER-QUALITY       MANAGEMENT OF BARNLOT RUNOFF TO IMPROVE DOWNSTREAM WATER QUALITY  KEYWORDS  SPRINKLER-I
200 71 0829  WATER-QUALITY       WATER QUALITY OF RUNOFF FROM GRASSLAND APPLIED WITH LIQUID, SEMI-LIQUID, AND DRY DAIRY
200 71 1252  WATER-QUALITY       NITRATE POLLUTION OF WATER KEYWORDS WATER-POLLUTION-SOURCES GROUNDWATER SURFACE-WATERS
200 72 1108  WATER-QUALITY       EFFECTS OF AGRICULTURAL LAND USE ON THE QUALITY OF SURFACE  RUNOFF KEYWORDS
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300 53 1206  WATER-QUALITY       POLLUTION OF STREAMS KEYWORDS DELAWARE WATER-POLLUTION STREAMS SOURCES
300 64 1110  WATER-QUALITY       LAKE TERMINOLOGY  WATER BLOOM KEYWORDS EUTROPHICATION ALGAE DUCKS COLOR FISHKILL LAKES
300 69 0093  WATER-QUALITY       HYDROLOGIC ASPECTS OF FEEDLOT WASTE CONTROL KEYWORDS BOD DO RIVERS WATER-QUALITY STREAM
300 69 1060  WATER-QUALITY       FOULING OF WATERS A MISDEMEANOR KEYWORDS NORTH-DAKOTA SOURCES WATER-POLLUTION-CONTROL
300 69 1103  WATER-QUALITY       ENFORCEMENT OF WATER POLLUTION LAWS IN OKLAHOMA KEYWORDS OKLAHOMA WATER-POLLUTION-SOURC
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300 70 1248  WATER-QUALITY       LIVESTOCK INDUSTRIES IN TEXAS AS RELATED TO WATER QUALITY REPORT NUMBER ONE KEYWORDS
300 71 1055  WATER-QUALITY       ANNUAL REPORT OF ACTIVITIES DURING FISCAL YEAR 1971 KEYWORDS WATER-RESOURCES WATER-USER
300 71 1056  WATER-QUALITY       AN ANALYSIS OF THE ECONOMIC IMPLICATIONS OF THE PERMIT SYSTEM OF WATER ALLOCATION KEYWO
300 73 1009  WATER-QUALITY       STREAM POLLUTION FROM CATTLE FEEDLOT RUNOFF KEYWORDS WATER-POLLUTION CATTLE FARM-WASTES
500 70 0409  WATER-QUALITY       ECONOMIC-ASPECTS  KEYWORDS  WATER-QUALITY COSTS BENEFITS QUALITY-LEVELS EXTERNALITIES M
500 70 0411  WATER-QUALITY       ACCOMPLISHMENTS AND GOALS  KEYWORDS  WATER-POLLUTION WATER-QUALITY FWPCA STANDARDS ENVI
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200 69 0181  WATER-QUALITY-ACT   FEEDLOT POLLUTION CONTROL-A PROFILE FOR ACTION  KEYWORDS  WATER-POLLUTION LEGISLATION G
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300 70 1192  WATER-QUALITY-ACT   IMPLICATIONS OF WATER QUALITY LAWS FOR THE FEEDLOT INDUSTRY KEYWORDS CONTROL POLLUTION-
400 68 0038  WATER-QUALITY-ACT   PONDS STOP POLLUTION FROM FEEDLOTS  KEYWORDS  PONDS KANSAS  WATER-QUALITY-ACT DAMS RUNO
200 69 0546  WATER-QUALITY-CONT  THE KANSAS ANIMAL WASTE CONTROL PROGRAM  KEYWORDS  LEGISLATION CATTLE INVESTIGATIONS WA
300 53 1206  WATER-QUALITY-CONT  POLLUTION OF STREAMS KEYWORDS DELAWARE WATER-POLLUTION STREAMS SOURCES
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300 69 1203  WATER-QUALITY-CONT  FOULING OF WATERS A MISDEMEANOR KEYWORDS NORTH-DAKOTA SOURCES WATER-POLLUTION
300 70 1201  WATER-QUALITY-CONT  OKLAHOMA FEED YARDS ACT KEYWORDS OKLAHOMA WATER-POLLUTION CONTROL SURFACE
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400 70 1237  WATER-REQUIREMENTS  POLLUTION POTENTIAL OF SALMONID FISH HATCHERIES KEYWORDS SOURCES FISH-HATCHERIES SALMON
200 71 0611  WATER-RESOURCES-DE  U  S  D  A  TECHNICAL AND FINANCIAL ASSISTANCE PROGRAMS  KEYWORDS  ADMINISTRATIVE-AGENC
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300 68 1123  WATER-REUSE         A FEASIBILITY STUDY OF A LIVESTOCK WASTE DISPOSAL SYSTEM INVOLVING THE REUSE OF WATER K
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400 68 0229  WATER-SHED-PROTECT THE FARM ROLE IN WATER-QUALITY MANAGEMENT  KEYWORDS SEDIMENT FERTILIZERS WATER-POLLUTIO
300 69 1103  WATER-SOURCES      ENFORCEMENT OF WATER POLLUTION LAWS IN OKLAHOMA KEYWORDS OKLAHOMA WATER-POLLUTION-SOURC
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100 71 1212  WATER-SUPPLY       EFFECTS OF MULTIPLE USE ON WATER QUALITY OF HIGH MOUNTAIN WATERSHEDS BACTERIOLOGICAL IN
300 53 1206  WATER-SUPPLY       POLLUTION OF STREAMS KEYWORDS DELAWARE WATER-POLLUTION STREAMS SOURCES
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300 69 1044  WATER-TABLE        IN SOIL PROFILES AND ON TRANSFORMATIONS OF SOIL NITROGEN KEYWORDS NITRIFICATION SOIL-NI
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200 71 1094  WATER-TREATMENT    AGRICULTURE AND POLLUTION--SOCIO-ECONOMIC ASPECTS KEYWORDS WATER-POLLUTION ECONOMICS SU
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300 68 1209  WATER-WELLS        ATKINSON V HERINGTON CATTLE COMPANY FEED LOT OPERATORS AND  CATTLE OWNERS JOINT LIABILI
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400 65 1141  WATER-WELLS        NITRATES DANGER FOR HUMANS, TOO KEYWORDS FEED-LOTS WATER-WELLS NITRATES FARM-WASTES MIS
100 70 1217  WATER-ZONING       APPLYING BACTERIOLOGICAL PARAMETERS TO RECREATIONAL WATER QUALITY  KEYWORDS REACREATION
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400 71 1139  WEATHER            HOW WEATHER AFFECTS FEEDLOT PERFORMANCE KEYWORDS MUD RAIN WIND FEED-LOTS FARM-WASTES WE
100 70 1237  WEEDS              POLLUTION POTENTIAL OF SALMONID FISH HATCHERIES KEYWORDS SOURCES FISH-HATCHERIES SALMON
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SECTION VII

ABSTRACTS OF BIBLIOGRAPHY ENTRIES

0001 - C1, D1, E1, F2, F4

SWINE HOUSING AND WASTE MANAGEMENT - A RESEARCH REVIEW,
National Pork Producers Council; Illinois Univ., Urbana. Coll. of Agriculture.
Arthur J. Muehling.
Department of Agricultural Engineering, College of Agriculture, University of Illinois at Urbana-Champaign, August 1969. 91 p, 232 ref. A. Eng.-873.

Descriptors: *Farm wastes, *Hogs, *Confinement pens, *Aerobic treatment, *Anerobic digestion, Odor, Economics.
Identifiers: *Oxidation ditch, *Housing, Space requirements, Slotted floors, Methods of disposal, Legal implications.

Current and past research in swine housing and waste management is reviewed and summarized. The author utilized 77 references in Part I of the report on swine housing studies. Research on production units, space requirements, slotted floors, and economics of swine housing systems is presented in summary form. Recommendations for future swine housing research are made. 155 references were utilized in Part II of the report on waste management studies. Properties of swine wastes, treatment and return of swine wastes to the land, other methods of disposal, gases and odors, and legal implications of waste handling are summarized. Recommendations for future research in waste management are made. Six fact sheets available from the National Pork Producers Council, Des Moines, supplement the research review. (White-Iowa State)

0002 - D4

SWINE WASTE MANAGEMENT-ANAEROBIC LAGOONS,
Illinois Univ., Urbana. Dept. of Agricultural Engineering.
Arthur J. Muehling.
Cooperative Extension Service, University of Illinois at Urbana-Champaign, August 1969. 2 p. AENG-877.

Descriptors: *Hogs, *Farm wastes, *Anaerobic conditions, *Lagoons, Size, Sites, Construction, Shape, Depth, Odors, Sludge, Water pollution, Temperature, Intakes, Outlets, Grading, Management, Mixing, Organic matter, Stabilization.
Identifiers: *Loading rates, *Location, Solids, Wind action, Gas bubbling, Volatile solids.

Anaerobic lagoons were first adapted for the storage and treatment of hog wastes because of their low initial cost, ease of operation, and lack of serious alternatives. They have not always been successful, for sometimes they release objectional odors, they can pollute surface and underground water, they sometimes do not decompose the manure adequately, and in time they are apt to fill up with sludge. This fact sheet gives advice as to loading rates, size and location of anaerobic lagoons. Attention is given to the construction shape, depth, inlets and outlets, fencing, and grading of banks. Management practices include an adequate supply of water, correct start-up, continuous loading rates, restriction of solids, and adequate mixing. (White-Iowa State)

0003 - B1

CONFINEMENT SWINE HOUSING - SPACE REQUIREMENTS,
Illinois Univ., Urbana. Dept. of Agricultural Engineering.
Arthur J. Muehling.
Cooperative Extension Service, University of Illinois at Urbana-Champaign, August 1969. 2 p. AEng-874.

Descriptors: *Size, *Seasonal, *Temperature, *Ventilation, Farm wastes, Hogs, Confinement pens, Management, Performance, Economics.
Identifiers: *Space requirements, Method of feeding, Number of pigs per pen, Heat stress.

As confinement housing has changed to include total enclosure of feeding and sleeping area under roof, the minimum space requirements recommended for pigs in confinement have been reduced. These recommendations indicate the minimum amount of floor space per pig necessary to prevent a significant reduction in pig performance and to maintain a reasonable degree of cleanliness in the pen. The fact sheet lists space requirements for different weight ranges of hogs. These recommendations are based on research that has considered the more important factors affecting space needs. The factors discussed in the fact sheet include size of animal, season (as related to temperature), ventilation, method of feeding, level of management, and number of pigs per pen. (White-Iowa State)

0004 - B1

CONFINEMENT SWINE HOUSING - SLOTTED FLOORS,
Illinois Univ., Urbana. Dept. of Agricultural Engineering.
Arthur J. Muehling.
Cooperative Extension Service, University of Illinois at Urbana-Champaign, August 1969. 2 p. AEng-875.

Descriptors: *Construction materials, *Reinforced concrete, *Metals, Farm wastes, Dimensions, Corrosion, Failure, Durability, Depth, Height, Length, Reinforcement, Hog.
Identifiers: *Slotted floors, *Wood, *Spacing, Expanded metal, Farrowing, Feed wastage.

This fact sheet lists wood, concrete and metal as being effective for slotted floors. Advantages and disadvantages of each type are given, as well as dimensions that should be used. Expanded metal and steel straps are both discussed as to their effectiveness for slotted floors. The amount and kind of reinforcing to use in concrete slats is given. Recommended spacing and advice for farrowing on slotted floors is also given. Pens with totally slotted floors remain consistently cleaner than those partially slotted. In general, the larger the pig the wider the slat that can be used without sacrificing cleaning efficiency. (White-Iowa State)

0005 - C2, C3, C4, C5

SWINE WASTE MANAGEMENT - PROPERTIES OF SWINE WASTES,
Illinois Univ., Urbana. Dept. of Agricultural Engineering.
Arthur J. Muehling.
Cooperative Extension Service, University of Illinois at Urbana-Champaign, August 1969. 2 p. AEng-876.

Descriptors: *Farm wastes, *Physical properties, *Chemical properties, *Biological properties, Hogs, Antibiotics, Nitrogen, Potash, Biochemical oxygen demand, Chemical oxygen demand, Nutrients, Animal physiology, Biological treatment.
Identifiers: *Daily production, *Fertilizer value, Phosphoric acid, Population equivalent, Feed ration, Solids.

An understanding of the properties of swine wastes is necessary to develop an adequate system of waste management. The properties of swine wastes as classified by this fact sheet are physical, chemical, and biological. The physical and chemical properties may be affected by the physiology of the animal, the feed ration, and the environment. The quality of feed influences the amount the hogs will eat and the chemical composition of the wastes. The physical properties of daily production and amount of solids are listed by this fact sheet. The fertilizer value of swine manure is shown and the amounts required to obtain certain pounds per acre of nitrogen, potash, and phosphoric acid are told. Average values for BOD, COD and population equivalent are listed as biological properties of swine manure. (White-Iowa State)

0006 - D4

SWINE WASTE MANAGEMENT - OXIDATION DITCH FOR TREATING HOG WASTES,
Illinois Univ., Urbana. Dept. of Agricultural Engineering.
Arthur J. Muehling.
Cooperative Extension Service, University of Illinois at Urbana-Champaign, August 1969. 2 p. AEng-878.

Descriptors: *Costs, *Farm wastes, *Hogs, *Design, *Rotors, Effluent, Volume, Storage, Oxygen, Biochemical oxygen demand, Aerobic bacteria, Organic matter, Calibrations, Foaming, Microorganisms, Odors, Dissolved oxygen, Color, Anaerobic bacteria, Sludge.
Identifiers: *Oxidation ditch, Rotor capacity, Rotor immersion, Rate of flow, Configuration, Detention time.

There has been considerable interest in aerobically treating hog wastes in an oxidation ditch because of the need for a low-odor method of manure storage and treatment. This fact sheet gives guidelines as to design shape, capacity and loading, rotor capacity and immersion, liquid depth and rate of flow. Operational procedures are given as well as a discussion of problems that may arise. Solutions to the problem of foaming include vegetable or petroleum oil, commercial products or a water spray. Sludge buildup and final disposal are given some attention. Rotor costs are about $250 per foot and operation costs are estimated to between 1/2 and 1 cent per day per hog. (White-Iowa State)

0007 - A5, A6, B1

SWINE WASTE MANAGEMENT - CASES FROM STORED SWINE WASTES,
Illinois Univ., Urbana. Dept. of Agricultural Engineering.
Arthur J. Muehling.
Cooperative Extension Service, University of Illinois at Urbana-Champaign, August 1969. 2 p. AEng-879.

Descriptors: *Farm wastes, *Hogs, *Gases, Odors, Carbon dioxide, Ammonia, Hydrogen sulfide, Methane, Lagoons.
Identifiers: *Threshold limit values (TLV), Air quality, Irritation, Lethal situations, Storage pit, Concentrations, Asphyxiation, Symptoms.

This fact sheet concerns itself about the quality of the air inside confinement swine buildings with slotted floors since the wastes may be held in the building long enough to produce gases and odors. Noxious gases and odors formed from stored wastes can be irritating to both the hogs and operator and have been the cause of numerous complaints and even lawsuits by neighbors. The most important gases generated from stored manure, and those discussed by the fact sheet are carbon dioxide, ammonia, hydrogen sulfide, and methane. The potentially lethal situations of ventilation breakdown, agitation of storage pit, and entering a storage pit are discussed and warnings given. (White-Iowa State)

0008 - D4

AEROBIC TREATMENT OF LIVESTOCK WASTES,
Illinois Univ., Urbana. Agricultural Experiment Station.
D. D. Jones, D. L. Day, and A. C. Dale.
University of Illinois Agricultural Experiment Station Bulletin 737, 1970. 55 p, 26 fig, 4 tab, 45 ref. HEW Grants EC-00245 and EC-00244.

Descriptors: *Oxidation lagoons, *Aeration, *Farm wastes, *Biochemical oxygen demand, Organic matter, Sludge disposal, Oxygenation, Hogs, Cattle.
Identifiers: *Oxidation ditch, *Aerobic lagoon, Livestock waste properties, Biochemical properties, Aerobic treatment, Irrigation system.

This report emphasizes the aerobic method of storage and treatment of livestock wastes primarily becuase of the low level of odors associated with aerobic treatment. An introduction to the theory of aerobic treatment is presented along with several laboratory experiments on swine, dairy cattle, and poultry wastes. These laboratory experiments verified the use of the aerobic method for livestock wastes. Two methods of aerobic treatment were studied and the results summarized. These were (A) the in-the-building oxidation ditch and (B) the aerobic lagoon (oxidation pond and aerated lagoon). Recommendations are made as to operator convenience, capacity, and design of the different systems. (White-Iowa State)

0009 - A5, D4

LIVESTOCK WASTE MANAGEMENT STUDIES-TERMINATION REPORT,
Illinois Univ., Urbana Agricultural Experiment Station.
D. L. Day, D. D. Jones, and J. C. Converse.
HEW Project No EC-245. July 1970. 97 p, 75 fig, 14 tab, 7 ref.

Descriptors: *Farm wastes, *Biochemical oxygen demand, *Chemical oxygen demand, *Odor, Hogs.
Identifiers: *Livestock oxidation ditch, Loading rates, Ditch mixed liquor, Optimum aerobic degradation, Aeration rotors, Operating cost, Feeding value of oxidation ditch solids.

This report deals mainly with results from laboratory tests and field trials of oxidation diches. Different loading rates were studied, and solutions to the problem of foaming were discussed. Most of the work was done with swine although laboratory tests were made with beef and dairy animals. Some research was done to determine the feeding value of oxidation ditch solids. The oxygenation capacity of rotors was discussed. A laboratory study of the minimum aeration for odor control was made using set design criteria. (White-Iowa State)

0010 - A2, B1, C1

THE EFFECT OF ANIMAL DENSITY AND SURFACE SLOPE ON CHARACTERISTICS OF RUNOFF, SOLID WASTES AND NITRATE MOVEMENT ON UNPAVED BEEF FEEDLOTS,
Nebraska Univ., Lincoln. Agricultural Experiment Station.
C. B. Gilbertson, T. M. McCalla, J. R. Ellis, O. E. Cross, and W. R. Woods.
Publication SB508, June 1970. 23 p, 5 fig, 7 tab, 23 ref.

Descriptors: *Rainfall-runoff relationships, *Chemical analysis, *Farm wastes, Chemical oxygen demand, Biochemical oxygen demand, Cattle, Laboratory tests, Detention reservoirs, Nitrates, Phosphorus.
Identifiers: *Dry matter removed (DMR), *Dry matter feces (DMF), Volatile solids, Feedlot slope, Cattle densities, Soil core samples, Feedlots.

The objectives of this study were to determine the effect of feedlot slope and cattle densities on: (1) The quantity and quality of runoff resulting from rainstorms and snowmelt, (2) Downward movement of pollutants into the soil profile on unpaved feedlots, and, (3) Amount of solids accumulation on the feedlot surface. Pairs of feedlots with 3, 6, and 9% slopes were installed. Ten and twenty cattle were placed in each pair of feedlots, which allowed 200 and 100 sq. ft. of area per animal. Volumetric measurement of runoff resulting from rainfall and snowmelt were made and samples of each runoff occurrence were taken to the laboratory for analysis. Laboratory analyses included pH, electric conductivity, total solids, non-volatile solids, total nitrogen, ammonium, nitrate, total phosphorus, COD and BOD. Soil cores were taken to depths of 14 ft. below the feedlot surface and adjacent buffer strips to determine downward movement of contaminants into the soil profile. Solids accumulations on the lot surface were removed twice. Weights of material removed were recorded and composite samples were taken to the laboratory for analyses. (Christenbury-Iowa State)

0011 - B3, F5

THE SEARCH FOR NEW POULTRY LITTER MATERIAL - AN EXAMPLE OF COOPERATION BETWEEN EXTENSION, RESEARCH AND INDUSTRY,
Georgia Univ., Athens. Dept. of Poultry Science.
Milton Y. Dendy, M. J. Reed, and M. G. McCartney.
Poultry Science, Vol 45, p 1666, 1968.

Descriptors: *Farm wastes, *Poultry, Physical properties, Performance, Agricultural engineering, Waste treatment, Pollutants.
Identifiers: *Litter materials, Pine bark, Pine bark and chips, Pine stump chips, Rice hulls, Poultry industry, Extension Poultrymen.

In the fall of 1966 a litter shortage was brought to the attention of the Extension Poultrymen during an industry meeting. The Extension Poultrymen took the problem to the research people in the Department of Poultry Science and the Department of Agricultural Engineering at the University of Georgia, and a project was started to test (1) the physical properties and performance characteristics of materials usable as litter in poultry houses, and (2) bird performance on several materials available in Georgia were tested, including pine shavings and pine sawdust, the two materials most commonly used. Results obtained indicate that some of the materials such as pine bark, pine bark and chips, pine stump chips and rice hulls are about as suitable for poultry litter as pine shavings or pine sawdust. (White-Iowa State)

0012 - A8

CONTROL OF HOUSE FLIES IN SWINE-FINISHING UNITS BY IMPROVED METHODS OF WASTE DISPOSAL,
Purdue Univ., Lafayette, Ind. Dept. of Entomology.
R. C. Dobson, and F. W. Kutz.
Journal of Economic Entomology, Vol 63, No 1, February 1970. 6 fig, 3 ref.

Descriptors: *Farm wastes, *Hogs, Disposal, Lagoons, *Insect control, Vectors, Entomology.
Identifiers: *Control of house flies, *Waste disposal systems, Collection pit, Slotted floor.

Four swine-finishing units were equipped with different waste disposal systems to determine their effectiveness in preventing development of the house fly, Musca domestica L. Each unit was completely screened to prevent contamination from outside sources. No insecticides were used. One of the 4 was a standard shed-type house used as a control. The other 3 units were equipped with new and improved waste disposal systems. Results from 2 years of study indicate that house fly production in and around swine-finishing units can be greatly reduced by using 1 of the 3 improved methods of waste disposal described. (Miner-Iowa State)

0013 - A8, B3

INFLUENCE OF POULTRY-MANURE-REMOVAL SCHEDULES ON VARIOUS DIPTERA LARVAE AND SELECTED ANTHROPOD PREDATORS,
California Univ., Berkeley. Dept. of Entomology and Parasitology.
John H. Peck, and John R. Anderson.
Journal of Economic Entomology, Vol 63, No 1, February 1970, p 82-90. 11 fig, 7 ref.

Descriptors: *Farm wastes, *Poultry, *Larvae, *Insect control, *Entomology, Vectors.
Identifiers: *Manure removal, *Diptera larvae, *Arthropod predators, Sampling, Control of flies.

The effects of weekly manure removal, monthly removal, and no removal on populations of fly larvae and slected predators (Acarina: Machrocheles muscaedomesticae Scopoli, Fuscuropods sp. (undescribed), Parasitidae; Coleoptera: Staphylinidae, Histeridaw, Hydrophilidae; Diptera: Ophyra leucostoma (Wiedemann) were studied for a full fly season at each of 2 northern California ranches. Third-instar larvae of the house fly, Musca domestica L., the false stable fly, Muscina stabulans (Fallen), and Calliphoridae were most abundant in 1-week-old manure; those of the little house fly, Fannia canicularis (L.), the coastal fly, Fannia femoralis Stein, and the black garbage fly, O. leucostoma, reached greatest numbers in 2- to 3-week-old manure. Unremoved manure had the least numbers of dipterous larvae, with the exception of the stable fly, Stomoxys calcitrans (L.). All predators studied were most abundant in unremoved manure. Abstention from manure removal favored the predators; monthly or biweekly removal favored the dipterous larvae. (Miner-Iowa State)

0014 - B1

INFLUENCE OF SPACE ON PERFORMANCE OF FEEDLOT CATTLE,
California Univ., Davis; and Agricultural Research Service, Davis, Calif.
S. R. Morrison, V. E. Mendel, and T. E. Bond.
Transactions of the ASAE, Vol 13, No 1, January 1970, p 145-147. 2 fig, 2 tab, 9 ref.

Descriptors: *Farm wastes, *Cattle, *Performance, *Confinement pens.
Identifiers: *Space, *Influence, *Weight gain, Feed efficiency.

Two tests in the Imperial Valley of California involving 74 heifers indicate that space allotments below 40 sq. ft. per head are likely to reduce the body weight gains and feed efficiency of feedlot cattle, and hot weather may accentuate the decrease. There is evidence suggesting that animal performance may be less even at 40 sq. ft. than at 60 sq. ft. per head. Tests with larger pens and more animals are desirable to establish the relation between gain and feed efficiency and pen space per animal. The range of space tested should be great enough to provide sufficient data to aid in designing feed lots for maximum profit. (White-Iowa State)

0015 - B1, E2

CATTLE FEEDERS AVOID POLLUTION BY USING WASTES IN IRRIGATION.
Soil Conservation Service, Washington, D.C.

Soil Conservation, Vol 34, No 4, November 1968, p 84-86. 3 fig.

Descriptors: *Farm wastes, *Cattle, *Ponds, *Furrow irrigation, Lagoon, Water pollution, Nebraska, Water Quality Act, Costs, Loess.
Identifiers: *Tractor driven pump, Soil Conservation Service, Feedlots.

Two brothers in Franklin county Nebraska have implemented a system that avoids pollution while fertilizing and irrigating their land. Solid wastes are hauled to the field from their 5 feedlots covering four acres. The rest washes down with every rain and is caught in a farm pond in a natural draw. In the bottom of the pond a lagoon-type pit was dug so there will always be some water available to keep wastes in suspension From here the suspension is pumped to nearby fields by a tractor driven pump If it doesn't rain they pump water from their irrigation wall into the pond and out again onto the land (White-Iowa State)

0016 - A4

FERTILIZERS AND FEEDLOTS — WHAT ROLE IN GROUNDWATER POLLUTION.

Agricultural Research, Vol 18, No 6, December 1969, p 14-15

Descriptors *Farm wastes, *Soil contamination, *Fertilizers, *Nitrates, Water pollution, Nitrogen, Nitrites, Aquifers, Colorado, Denitrification, Water table, Percolation
Identifiers *Feedlots, South Platte River Valley

No significant contamination of the water table with nitrate from farm fertilizers or extensive cattle feeding operations was found in preliminary ARS studies in northeastern Colorado But studies indicated that substantial amounts of nitrate could eventually reach the water table under heavily fertilized irrigated fields and under feedlots ARS soil scientists measured nitrates in 129 soil cores drilled to bedrock or the water table and in 75 samples of groundwater taken with the cores in Colorado's South Platte River Valley The investigators found that, on the average, the kind of land use did not effect the nitrate concentration of water entering the bottom of the holes where the cores were taken The surface may contain more pollutants than water deeper in the aquifer (White-Iowa State)

0017 - C2

AN IMPROVED METHOD FOR PREPARATION OF FECES FOR BOMB CALORIMETRY,

School of Aerospace Medicine, Brooks AFB, Tex
Hubert G Lovelady, and Emmett J Stork
Clinical Chemistry, Vol 16, No 3, 1970, p 253-254 1 tab, 2 ref

Descriptors *Laboratory tests, Energy, Odor, *Farm wastes, Drying
Identifiers *Bomb calorimetry, Lyophilize

As a preliminary to bomb calorimetry, weighed, homogenized fecal slurries are prefrozen and lyophilized Advantages of this method over the method of drying in a vacuum oven include more moisture is removed from the sample initially, drying time is reduced from 48h to 16 h, grinding is eliminated and objectionable odors are eliminated during sample processing (Christenbury-Iowa State)

0018 - C4

SALMONELLA Spp. AND SEROTYPES OF ESCHERICHIA COLI ISOLATED FROM THE LESSER MEALWORM COLLECTED IN POULTRY BROODER HOUSES,

Minnesota Univ., St. Paul. Dept. of Entomology, Fisheries and Wildlife.
Philip K. Harein, Ernesto De LasCasa, B. S. Pomeroy, and Mabel D. York.
Journal of Economic Entomology, Vol 63, No 1, February 1970, p 80-82. 3 tab, 20 ref.

Descriptors: *Farm wastes, *Poultry, *Salmonella, *E. coli, Cultures.
Identifiers: *Isolated, *Brooder houses, Litter, Mealworms, Pathogens.

Adult Alphitobius diaperinus (Panzer) were collected from the litter of poultry brooder houses in 1967 and 1968. One thousand of the lesser mealworms were individually surface disinfected, mascerated, and cultured in thioglycolate enrichment broth at 37 degrees C and streaked on eosin methylene blue agar or brilliant green agar plates for detection of Escherichia coli (Migula) Castelani and Chalmers and Salmonella spp., respectively Five species of Salmonella found within the lesser mealworms were identified as S heidelberg Kauffman, S worthington Edwards and Bruner, S saint paul Kauffman, S typhimurium var copenhagen Kauffman, and S chester Kauffman and Tesdal Forty-eight serotypes of E coli were recovered from within 251 lesser mealworms Twenty-six of these serotypes are known pathogens for man or animals (Miner-Iowa State)

0019 - A5, D1

CONTROL OF ODORS FROM ANIMAL WASTES,

W E Burnett, and N C Dondero
Transaction of the ASAE, Vol 13, No 2, p 221-224, 231, March 1970 3 fig, 5 tab, 15 ref

Descriptors *Farm wastes, *Poultry, *Odor, *Chemicals, Costs
Identifiers *Odor panel, *Masking agents, *Counteractants, Deodorants, Digestive deodorants, D indices

A matching-standard method was successfully used for the evaluation of the ability of commercial odor-control chemicals to mask or eliminate the offensive odor of poultry manure when added directly to the waste in both laboratory and field tests The method enables one to find the most effective chemicals in a systematic and relatively time-saving manner The method provides information on the lowest concentration of chemical necessary to obtain a desired effect Masking agents and counteractants were found to be the most effective odor-control products, deodorants were moderately effective, and digestive deodorants were least effective The cost in some field trials was estimated to be 63 cents per 450 gal of liquid manure Further research is needed on the effect of repeated applications of odor-control products on soil, so as not to harm the soil for other purposes (White-Iowa State)

0020 - C5, E3

EFFECT OF DIETS CONTAINING DEHYDRATED POULTRY WASTE ON QUALITY CHANGES IN SHELL EGGS DURING STORAGE,

Michigan State Univ., East Lansing Dept of Poultry Science
L R York, C J Flegal, H C Zindel, and T H Coleman
Poultry Science, Vol 49, No 2, p 590-591, March 1970 1 tab, 3 ref

Descriptors *Farm wastes, *Poultry, *Dehydration, *Diets, Eggs
Identifiers *Haugh unit, *Qaulity changes, Color and odor observations, Waste feeding, Manure utilization, Dried poultry wastes

Eggs from 32 Leghorn-type hens on each of four diets were used All the birds were 10 months of age and had been on the experimental diet for three months The diets used were (1) control, (2) control with 10% DPW, (3) control with 20% DPW, and (4) control with 30% DPW. One-day-old eggs were stored at room environment to accelerate the changes that occur during storage Room temperature varied from 22 degrees C to 25 degrees C and relative humidity varied from 50% to 68%. Eggs were gathered on five consecutive days and held for storage periods of 10, 20, 30, 40 or 50 days Physical and microbiological examinations were made at the beginning of the trial and at the end of the designated storage periods. The results of this experiment indicate that including 10, 20, or 30% dehydrated poultry waste in the diet of hens had no significant deleterious effect on the quality of shell eggs as measured by Haugh units, storage weight loss, color, odor, and/or microbial content (Miner-Iowa State)

0021 - E2, E3

EFFECT OF MANURE APPLICATION, AERATION, AND SOIL pH ON SOIL NITROGEN TRANSFORMATIONS AND ON CERTAIN SOIL TEST VALUES,

Wisconsin Univ., Madison Dept of Soils
R J Olsen, R F Hensler, and O J Attoe
Soil Science Society of America Proceedings, Vol 34, No 2, p 222-225, March-April 1970 2 fig, 2 tab, 10 ref

Descriptors *Nitrification, *Denitrification, *Farm wastes, *Aeration, Soil tests, Rates of application
Identifiers N recovery, Field moisture capacity, *Soil nitrogen transformations, Soil pH, Nitrate production

Nitrate production under aerobic conditions was directly related to rate of manure application, period of incubation and soil pH, but was stopped under anaerobic conditions Average recovery by chemical analysis of N applied as manure to a Plainfield sand at relatively high rates and incubated for 37 weeks was 77% for aerobic conditions and 24% for anaerobic conditions The addition of manure tended to increase soil pH and the contents of organic N, available P and exchangeable K, Ca, and Mg, particularly at the higher rates They also increased the field moisture capacity of a Plainfield sand However, on an acid Ella loamy sand the two highest rates of manure caused a reduction of the values for field moisture capacity, apparently the result of formation of a waxy material that tended to repel water absorption (Miner-Iowa State)

0022 - A5, D4

SIMPLE SYSTEM FOR AERATING MANURE LAGOONS,

DeKalb AgResearch, Inc., Ill
Jay Gilliland
Poultry Digest, Vol 29, p 330-331, July 1970 1 fig

Descriptors: *Farm wastes, *Poultry, *Sedimentaitation, *Aeration, Anaerobic conditions, Aerobic conditions, Odors, Sulfides, Methane, Construction costs, Operation and maintenance, Cost analysis, Erosion, Waste water treatment

An aerated lagoon system was designed to treat the 1780 cu yds of manure produced annually by two 30,000-hen automatic environmental controlled laying houses, instead of relying on spreading the manure on the land A 100 ft by 200 ft lagoon with a12 ft depth and a two-to-one side slope was constructed at a cost of $900, having an estimated 10 year life A six nozzle irrigation sprinkler run by a centrifugal irrigation pump with a 5 hp motor provides aeration at a cost of $2 20 per day Water is drawn from just below the surface and sprayed into the air in order to reduce odors The methane and hydrogen sulfide gases generated by anaerobic action on the lagoon bottom are dissipated by aerobic bacteria near the top and their odor eliminated This method has been demonstrated to be a low costs disposal, low cost upkeep system particularly suited for this job (Lowry-Texas)

0023 - C1

ATTRACTION OF COPROPHAGOUS BEETLES TO FECES OF VARIOUS ANIMALS,

Georgia Coastal Plain Experiment Station, Tifton
G Truman Fincher, T Bonner Stewart, and Robert Davis
The Journal of Parasitology, Vol 56, No 2, April 1970, p 378-383 2 tab, 20 ref

Descriptors: *Farm wastes, *Insects, *Habitats, Animal, Intermediate hosts
Identifiers *Beetle species, Pit traps, Feces, Woodland habitat, Swine pasture, Dairy pasture

Beetles were attracted to pit traps baited with the feces of one of 12 different animals in 3 habitats

Comparison of the 3 habitats showed marked differences in beetle fauna. Most dung beetles were captured in traps baited with swine feces. Swine and opossum feces attracted 57.7% of all beetles captured and 74.8% of the Phanaeus species which are the major intermediate hosts of swine spirurids in southern Georgia. Captured beetles comprised 12 genera with more than 18 species. (White-Iowa State)

0024 - A9, C4

PROBABLE SOURCES OF SALMONELLAE ON A POULTRY FARM,

Punjab Agricultural Univ., Hissar (India). Dept of Veterinary Bacteriology and Hygiene.
S. M. Goyal, and I. P. Singh.
British Veterinary Journal, Vol 126, No 4, p 180-184, 1970. 2 tab, 17 ref.

Descriptors: *Farm wastes, *Salmonella, *Poultry, *Farm, Domestic animals, Rodents, Reptiles.
Identifiers: Salmonellosis, Transmission, Cross-infection.

This study was undertaken to determine various sources of Salmonellae on a poultry farm. Pigs, sheep, and other domestic animals were checked, as well as rats, sparrows, birds, and wall lizards. Eight Salmonellae types were isolated from poultry, pigs, rats, wall lizards, and house sparrows. S. anatum was isolated from all these sources and S. stanley from rats and poultry, indicating the possibility of cross-infection due to multiple foci of Salmonella infections. Rodents, free-flying birds and lizards were considered as important sources of Salmonellae. (White-Iowa State)

0025 - A9, B1

BACTERIAL CONTAMINATION IN POULTRY HOUSES AND ITS RELATIONSHIP TO EGG HATCHABILITY,

Pennsylvania Univ., University Park. Dept of Poultry Science.
C. L. Quarles, R. F. Gentry, and G. O. Bressler.
Poultry Science, Vol 49, No 1, p 60-66, 1970. 8 tab, 15 ref.

Descriptors: *Farm wastes, *Bacteria, *Poultry, *Fertility, Eggs.
Identifiers: *Egg contamination, Egg hatchability, Air sampler, Litter houses, Litter nests, Wire floors, Roll-away nest.

This study was designed to determine if there was any relationship among poultry house contamination, egg contamination and hatchability. A high density sloping wire floor system was compared with the conventional litter floor system. Rates of egg production and fertility were similar in both systems. Litter houses averaged 9 times as many bacteria per cubic foot of air as wire floor houses. An attempt was made to study the level and transmission of coliform type bacteria as related to type of house and nest used. Hatchability of eggs in wire flood pens was superior to eggs from litter floor pens. Fungal contamination of air was approximately the same for both systems. (White-Iowa State)

0026 - C4

A RAPID AND SIMPLE METHOD FOR THE DETECTION AND ISOLATION OF SALMONELLA FROM MIXED CULTURES AND POULTRY PRODUCTS,

Iowa State Univ., Ames. Dept. of Food Technology.
Daniel Y. C. Fung, and Allen A. Kraft.
Poultry Science, Vol 49, No 1, p 46-54, 1970. 1 fig, 7 tab, 7 ref.

Descriptors: *Isolation, *Salmonella, *Poultry, *Cultures, Farm wastes.
Identifiers: Poultry products, Motility flask, Concentrations, Strains.

This report deals with results obtained using a new rapid method of Salmonellae detection and isolation in mixed cultures, turkey and chicken products, and whole eggs. The paper describes a simple system, combining biochemical and physical properties of Salmonella, which can detect small numbers of Salmonella in the presence of large numbers of competitive organisms. Motility multilayered agar flasks were used in the test. Typical complete Salmonella reactions were obtained in the control flask as early as 17-36 hours of incubation, as compared with 48-96 hours by conventional methods. This system has the potential as a simple and rapid method for large scale screening test for Salmonellae in a variety of commercial food products. (White-Iowa State Univ)

0027 - C5

EFFECT OF STRESS ON SWINE: HEAT AND COLD EXPOSURE AND STARVATION ON VANILMANDELIC ACID OUTPUT IN THE URINE,

Guelph Univ. (Ontario). Dept. of Nutrition.
M. P. Stefanovic, H. S. Bayley, and S. J. Slinger.
Journal of Animal Science, Vol 30, No 3, p 378-381, 1970. 1 fig, 2 tab, 12 ref.

Descriptors: *Hogs, Air temperature, *Urine, Amino acids, *Farm wastes.
Identifiers: Vanilmandelic acid output, Starvation, Metabolic response.

Tests were performed on 3 Yorkshire pigs in which they were subjected to normal conditions, extreme temperatures of 5 and 33C, and finally starved for 10 days at 20C. The urinary excretion of 3-methoxy - 4-hydroxymandelic acid (VMA) was measured when the pigs were housed in cages maintained at a room temperature of 20C. Observations of the VMA content was also made at times the pigs were under the stress conditions. The pigs increased in weight from 8 to 30 kg during the 70 day experiment. Under normal temperature they excreted 10 mg of VMA per 24 hours. This increased to between 20 and 30 mg when the pigs were exposed to the low temperature. Exposure to the high temperature resulted in an excretion of 20 mg per day, but starvation caused a rapid decline to 3 mg per day. The excretion returned to normal values very rapidly when the animals were refed. These observations are discussed in relation to those made by other authors with other species on the effects of stress on the release and metabolism of catecholamines and their excretion in the urine, and it is suggested that the urinary output of VMA offers a convenient method of measuring physiological response to stress in the pigs. (White-Iowa State)

0028 - A8, B3, E4

HOUSEFLY LARVAE: BIODEGRADATION OF HEN EXCRETA TO USEFUL PRODUCTS,

Agricultural Research Service, Beltsville, Md.
C. C. Calvert, N. O. Morgan, and R. D. Martin.
Poultry Science, Vol 49, No 2, p 588-590, March 1970. 2 tab, 3 ref.

Descriptors: *Farm wastes, *Livestock, *Manure, *Poultry, Insects, Waste treatment, Ultimate disposal, Waste disposal, Odor.
Identifiers: House fly, Hen, Fly eggs, Manure treatment, Waste utilization.

This report presents the results of experiments to establish the concentration of fly eggs that can be used to process hen excreta most efficiently, and a means of separating the house fly pupae from the processed hen excreta and to simplify their collection. Within four days after seeding with house fly pupae the odor of the manure became unobjectionable. After eight days the excreta was reduced to an essentially odorless and friable material. The separated pupae were utilized as a protein source in the diet of growing chicks. (Miner-Iowa State)

0029 - E3

DRIED POULTRY MANURE AS CATTLE FEED,

NAAS, Cambridge.
C. B. Fairbairn.
Poultry Digest, July 1970, p 331, Vol. 29, No. 341.

Descriptors: *farm waste, *manure, *poultry, drying.
Identifiers: manure feeding, poultry manure, nutritional value.

Presents data on the nutritional value of dried poultry manure with and without litter. The energy value for dried litter is 500 calories per pound which is about one third that for grain. Protein value was similar to cereal. It was shown to be suitable for inclusion in intensive beef rations. (Miner-Iowa State)

0030 - D4, E2

TREATMENT OF DAIRY MANURE BY LAGOONING,

Washington State Univ., Pullman.
Surinder K. Bhagat, and Donald E. Proctor.
Journal Water Pollution Control Federation, Vol 41, No 5, 1969, p 785-795. 9 fig, 7 tab, 6 ref.

Descriptors: *Farm wastes, *Farm lagoons, *Biodegradation, Algae, Biochemical oxygen demand, Anaerobic digestion, Aerobic treatment, Chemical oxygen demand, Storage capacity, Effluents, Construction.
Identifiers: *Dairy manure, Total solids, Volitile solids, Non-degradable solid.

Because of high solids content of dairy manure waste, anaerobic lagoons can be used satisfactorily as a primary waste treatment. Average removals of BOD, COD, TS, and VS above 86 percent can be accomplished with an applied loading of 70 lb VS/day/1000 Cu. Ft. (1120 g/day/cu. m.). An anaerobic lagoon can act as a sedimentation, flotation, and anaerobic digestion process unit while simultaneously providing long-term storage for non-degradable solid residue. The effluent from the anaerobic lagoon retains most of the nutrients present in the raw manure waste and thus has fertilizer value. The effluent has organic matter which can be oxidized. The effluent can be applied to a field or subjected to further treatment. The secondary treatment can be an aerated lagoon, oxidation ditch, or an oxidation pond. The results of the batch type aerobic treatment indicated that an effluent BOD at 20 mg/l can be achieved by a 24-hr aeration period. (Christenbury-Iowa State)

0031 - C2, C3

VOLATILIZATION AND NITRIFICATION OF NITROGEN FROM URINE UNDER SIMULATED CATTLE FEED LOT CONDITIONS,

Agricultural Research Service, Fort Collins, Colo. Soil and Water Conservation Research Div.
B. A. Stewart.
Environmental Science and Technology, Vol 5, No 7, p 579-582, July 1970. 1 fig, 7 tab, 7 ref.

Descriptors: *Nitrification, *Cattle, *Soils, Ammonia, Nitrogen Moisture content, Depth, Chemical oxygen demand, Farm wastes, Urine.
Identifiers: *Feed lots.

Virtually all the recent growth in cattle feeding has been in feeding units of 10,000 head or more in which cattle are confined in pens allowing 6 to 20 sq meters per animal. Animal wastes resulting from these large feeding operations cause concern in many areas. Disposal of the accumulation of solids wastes is difficult and in some cases run-off from these lots has caused pollution of streams and lakes. Feeding operations can cause high nitrogen concentrations in the underground water supply. There are large differences in the amount of nitrate found under feed lots: some contain large amounts, other nearly nitrate free, both at shallow and deep depth. The objectives were to simulate some feed lot conditions and study the nitrification and volatilization weights of nitrogen added as cattle urine to soil in an attempt to determine some of the factors governing nitrate accumulation under feed lots. Urine accounts for about half of the nitrogen excreted by cattle. When urine was added every two days to an initial wet soil at a rate of 5 ml per 21 cm sq, less than 25% of the nitrogen was lost as ammonia and about 65% converted to nitrate. When urine was added every 4 days to initially dry soil, essentially all the water evaporated between the urine additions, and 90% of the nitrogen was lost as ammonia. These findings suggest that the stocking rate and other management factors should be considered in pollution of the unit. (Hancuff-Texas)

0032 - E2

NATURAL FILTERS FOR AGRICULTURAL WASTES,
Soil Conservation Service, Washington, D.C.
W. E. Bullard, Jr.
Soil Conservation, Vol 34, No 4, November 1968, p 75-77. 2 fig.

Descriptors: *Farm wastes, *Sprinkler irrigation, *Organic wastes, *Waste water disposal, Air pollution, Water pollution, Odor, Effluents, Sewage effluents, Dilution, Decomposing organic matter, Insects, Mites, Bacteria, Fungi, Algae, Nitrites, Nitrates, Detergents, Phosphates.
Identifiers: *Biologic 'disposers', Microscopic organisms, Papermill waste effluent, Cheese factory waste waters.

Farmers and processors of farm products are finding that the waste products of their operations generally can be returned to the land with less hazard to the environment than when discharged into streams. By completing the natural cycle of growth, death, and decay on the land where crops are produced they make use of a legion of 'disposer' organisms in the soil capable of decomposing organic wastes on site. When sprayed on grass or crops, the effluent serves the dual purpose of irrigating and fertilizing the field, thus, agriculture has the potential means of disposing of its own wastes and preventing or reducing environmental pollution. Numerous examples are given of returning sewage treatment effluents, pulp and papermill effluents, and cheese factory waste waters, among others, to the land by sprinkler irrigation. The principle behind these successful operations is that of getting material produced from the land back onto the land where they can be used again in production. (White-Iowa State)

0033 - E2

IRRIGATING WITH ANIMAL WASTE,
Soil Conservation Service, Hermiston, Oreg.
Clarence Underwood.
Soil Conservation, Vol 34, No 4, November 1968, p 81-82. 3 fig.

Descriptors: *Farm wastes, *Hogs, *Irrigation, *Sewage disposal, Effluent, Soil conservation, Odor, Fertilization, Lagoons, Sprinkler irrigation, Nitrogen, Waste dilution, Water pollution.
Identifiers: *Soil Conservation Service, Velocity-controlled water outlets, Holding basin.

Two brothers purchased a civilian housing facility from the Umatilla Army Depot and converted the 57 units to hog production. Wastes from the 22,000 hog per year facility are flushed into a gutter, through a sewer system and into the first of two lagoons. A second holding basin allows additional settlement and dilution of solids. From here it is pumped to irrigate about 500 acres of land. The brothers estimate that their system puts about 5 pounds of nitrogen per acre on a field each time it is irrigated. The crops are fertilized, little odor is noticeable, and no water pollution has been detected. (White-Iowa State)

0034 - C3

A RAPID EXTRACTION AND QUANTIFICATION OF TOTAL LIPIDS AND LIPID FRACTIONS IN BLOOD AND FECES,
Pittsburgh Univ., Pa. Dept. of Pathology.
J. S. Amenta.
Clinical Chemistry, Vol 16, No 4, 1970, p 339-346. 8 fig, 19 ref, 1 tab.

Descriptors: *Lipids, *Laboratory tests, Chemical analysis, Farm wastes.
Identifiers: *Feces, Plasma, Lipid fractions, Clinical laboratory, Cholesterol.

An analytical system for plasma lipids suitable for use in the large and small clinical laboratory is presented. Lipids are extracted into a chloroform-methanol solvent and concentrated into a chloroform phase by a wash with an aqueous CaC12 solution. This extract is used to estimate total lipids and (after separation by thin-layer chromatography) the major lipid factions. A single acid dichromate reagent is used for all quantification of fecal lipids. Lipids in other body fluids can be conveniently analyzed with this flexible method. (Christenbury-Iowa State)

0035 - A5, B1, D1, E3

TREATMENT OF BEEF-CATTLE WASTE WATER FOR POSSIBLE REUSE,
North Dakota State Univ., Fargo.
G. L. Pratt, R. E. Harkness, R. G. Butler, J. L. Parsons, and M. L. Buchanan.
Transactions of the ASAE, Vol 12, No 4, 1969, p 471-473. 2 fig, 3 tab, 19 ref.

Descriptors: *Farm wastes, *Cattle, *Septic tank, Biochemical oxygen demand, Chemical oxygen demand, Hydrogen ion concentration, Effluents, Aeration, Dissolved oxygen, Turbidity, Aluminum.
Identifiers: *Settling tank, *Slatted floor, *Reuse, Total solids, Volatile solids, Aluminum sulfate.

Removing solid materials from wastes that have been washed from a livestock barn with water can be accomplished in several ways. In trials at the North Dakota Agricultural Experiment Station settling tanks were evaluated. Treatments of overflow from the settling tank by aeration and chemical coagulation were compared with settling only. The equipment consisted of an 8x8 foot animal shelter with a steel-slatted floor. Manure was washed from under the floor to a settling tank. A secondary treatment tank was installed to receive overflow from the settling tank. A pump end holding tank was used so that the effluent from the secondary treatment tank could be used in washing the floor under the steel slats. Aeration and treatment with alum did not upgrade the waste water sufficiently to make the water odorfree. It was also colored. Other treatment will be needed to remove the odor before the water can be suitable for reuse in washing the building. (White-Iowa State)

0036 - A9, E3

OBSERVATIONS ON THE EFFECT OF THE RE-USE OF BROILER LITTER ON THE INCIDENCE OF MAREK'S DISEASE,
Delaware Univ., Newark.
G. W. Chaloupka, R. W. Lloyd, J. F. Gordy, and L. M. Greene.
Poultry Science, Vol 47, p 1660, 1968.

Descriptors: *Farm wastes, *Condemnation, *Poultry, *Disinfection, Public health, Pollution abatement, *Diseases.
Identifiers: *Marek's disease, Broiler house, Litter re-use, Leucosis, Immunity, Causative agent.

Four different studies involving several trials have been conducted at the University of Delaware Substation in which the performance of broilers grown on re-used litter was compared to those grown on new litter. These studies over a period of several years have shown that broiler condemnations due to leucosis have in most instances been lower for the broilers grown on re-used litter. This substantiates the findings of many field studies and by at least one private research farm. These results would indicate that a failure to clean out and disinfect the broiler house before placing each new lot of chicks is not a primary factor in increasing the incidence of Marek's disease. It is not known whether these results are due to developing a partial immunity due to contact with the causative agent in the litter at an early age or whether the causative agent is destroyed in some way in the reused litter. (White-Iowa State)

0037 - A2, F2

WATER POLLUTION CONTROL LEGISLATION,
Cornell Univ., Ithaca, N.Y.
Raymond C. Loehr.
Condensation of report NA68-304 available from ASRE, St. Joseph, Mich. 49085, $0.50. Agricultural Engineering, Vol 50, August 1969, p 468-470. 8 ref.
Descriptors: *Farm wastes, *Water pollution, *Legislation, Water pollution control, Water Quality Act, Biochemical oxygen demand, Phosphates, Effluents.
Identifiers: *Treatment processes, Aerobic oxidation pond, Aerated lagoon, Oxidation ditch, Minimum removal efficiencies, Water quality criteria.

Agricultural production facilities must consider waste disposal as an important aspect of their operations. Waste treatment and disposal facilities are becoming important parts of agricultural production facilities. They must be evaluated whenever expansion or establishment of new facilities is underway. Highly efficient secondary treatment processes perhaps including nutrient removal and disinfection may be necessary for discharging waste waters to surface waters. The need for and cost of these processes should cause a re-evaluation of the comparative costs of handling, treatment, and disposal of agricultural wastes as a solid. Land disposal is another alternative. When agricultural wastes are handled to avoid polluting surface waters, other types of pollution must be avoided. Mere transferral of pollution from one sphere to another will no longer be tolerated. These are among the aspects which this paper deals with. (White-Iowa State)

0038 - A2, B1, E2

PONDS STOP POLLUTION FROM FEEDLOTS,
Soil Conservation Service, Salina, Kans.
George R. Smith, and F. DeWitt Abbott.
Soil Conservation, Vol 34, No 4, Nov 1968, p 78-79. 2 fig.

Descriptors: *Farm wastes, *Water Quality Act, Ponds, Kansas, Water pollution, Dams, Runoff, Soil, Sprinkler irrigation.
Identifiers: *Feedlots, Soil Conservation Service, Detention ponds, Kansas State Department of Health, Solid waste, Liquid waste.

In compliance with the Federal Water Quality Act of 1965 and a 1967 Kansas State law a northwest Kansas feedlot is retaining and disposing of animal wastes in a non-pollutional manner. The 14,000 head beef feedlots is located at the headwaters of a subdrainage area of Hackberry Creek. The feedlot, covering 100 acres, drains into two intermittent natural draws. Each draw has a pair of detention ponds. One collects solid wastes, and below this a second pond holds drainage from the first pond. Pipes with slide gates provide controlled drainage of liquids from the solid-waste ponds into the liquid waste ponds. The dams were built to state health department standards to contain 3 inches of runoff from the feedlot. The excess water from the lower ponds will be used for irrigation. The ponds are flat bottomed to facilitate removal of solid wastes. (White-Iowa State)

0039 - D4

LABOR-FREE MANURE DISPOSAL,

Purdue Univ., Lafayette, Ind. Dept. of Agricultural Engineering.
Rex Wilmore.
Farm Journal, Vol 93, No 8, August 1969, p 26C-26D. 1 fig.

Descriptors: *Farm wastes, *Aeration, *Lagoons, Aerobic bacteria, Effluent, Sprinkler irrigation, Storage capacity, Water pollution, Odors, Efficiencies, Slurries, Oxygen, Organic matter, Pumps, Labor, Costs, Management.
Identifiers: *Floating aerator, Suspended solids, Volatile solids.

Research at Purdue University indicates that a floating aerator in a lagoon can provide a low cost system that promises to avoid pollution dangers and saves labor. Manure is dumped into the lagoon once each day although it is better to have it continuously trickle in. Extra water is added to bring the solids content down to 2% or 3% for top efficiency. The aerator, a big doughnut-like float with an electric motor on top driving an impeller, runs continuously. The impeller forces a spray of slurry up over the float, mixing air into the lagoon, so aerobic bacteria can break down manure without odors. Periodically a small pump pulls out some of the mixed slurry and sprinkles it through a 'big gun' type nozzle onto grassland. The irrigation lowers the lagoon, which allows more water dilution and removes the suspended solids that won't decompose. Other advantages include low labor cost as compared to pits and spreaders, and minimal management. Its biggest disadvantage might be getting the manure into the lagoon each day. (White-Iowa State)

0040 - B3

PHYSICAL AND BIOLOGICAL EVALUATION OF FIVE LITTER MATERIALS,

Purdue Univ., Lafayette, Ind. Dept. of Animal Sciences.
Paul L. Ruszler, and James R. Carson.
Poultry Science, Vol 47, p 1712, 1969.

Descriptors: *Farm waste, *Poultry, *Absorption, Moisture, Particle size, Laboratory tests, Waste water treatment, Waste treatment, Water pollution effects.
Identifiers: *Litter materials, Field conditions, Peanut shells, Pine bark, Ground cobs, Wood shavings, Cane pomace.

The usefulness of peanut shells, pine bark, ground cobs, wood shavings and cane pomace as litter materials in rooster production was evaluated under laboratory and field conditions on the basis of their physical properties and effects on the birds during a 14-week growing period. When the amount and rate of moisture exchange was compared, it was found that all five materials differed significantly. When ranked by grams of moisture absorbed per gram of dry weight, cane was highest, followed by shavings, cobs, shell, and bark. The materials with the smaller particle sizes absorbed less total moisture in both growing house and laboratory tests. The same materials rated low in breast blister incidence, but without statistical significance. (White-Iowa State)

0041 - C1, E2

THE EFFECTS OF FARMYARD MANURE ON MATRIC SUCTIONS PREVAILING IN A SANDY LOAM SOIL,

National Vegetable Research Station, Wellesbourne (England).
P. J. Salter, G. Berry, and J. B. Williams.
Journal of Soil Science, Vol 18, No 2, 1967, p 318-328. 3 fig, 2 tab, 25 ref.

Descriptors: *Farm wastes, *Soils, *Soil moisture, Field capacity, Wilting point, Equations.
Identifiers: *Soil matric suctions, Ryegrass, Available-water capacity, Moisture characteristic.

Soil matric suctions under a crop of ryegrass on farmyard manure-treated and untreated plots were determined over a total period of 24 weeks from March to November. The soil moisture characteristic of each plot was determined five times throughout this period, and for each plot and on every occasion a linear relationship was found between moisture content and log matric suction. A formula was derived to account for the seasonal changes in moisture characteristic - and it was then possible to obtain matric suction values from the soil moisture contents obtained from twice-weekly sampling of each plot. Although differences between available-water capacity of the manured and unmanured plots were small throughout the 6-month period of sampling, the soil matric suctions of the manured plots were almost always lower than those of the unmanured plots. The lower suctions prevailing in the manured soil could be a factor contributing to the higher yields of ryegrass obtained from the manured plots as compared with those obtained from the unmanured plots. (White-Iowa State)

0042 - A3, E2

STREAM ENRICHMENT FROM FARM OPERATIONS,

Wisconsin Univ., Madison.
Neal E. Minshall, Stanley A. Witzel, and Merle S. Nichols.
Journal of the Sanitary Engineering Division, Proceedings of ASCE, Vol 96, No SA2, April 1970, p 513-524. 2 fig, 5 tab, 4 ref.

Descriptors: *Farm wastes, *Fertilizers, *Runoff, Nitrogen, Phosphorus, Potash, Wisconsin, Water pollution, Nutrients, Precipitation, Rates of application, Corn, Frozen ground.
Identifiers: *Nutrient losses, Collection tanks.

In order to obtain information on the amount of fertilizer materials lost in runoff water from farm lands under cultivation, eight plots, 10x40 ft. in size, were established on the University of Wisconsin Agricultural Experiment Station Farm near Lancaster, Wisconsin. Investigations involving fertilizer and manure applications and losses in surface runoff were begun in 1966 and were continued through 1969. Each plot was completely surrounded by a galvanized metal border which prevented surface runoff from entering or leaving the plots, located on a 10% to 12% slope. Runoff was collected in a trough at the lower end and funneled to a measuring tank. Manure was applied at the rate of 15 tons per acre in the winter and spring. Later corn was planted in 30 inch rows on the contour. Up to 20% of N, 13% of P, and 33% of K nutrients in winter applied manure, on frozen ground, may be lost under conditions favoring maximum early spring runoff. Nutrient losses in surface runoff from plots having manure applied in the summer and incorporated into the soil were less than from check plots, which received no manure. (White-Iowa State)

0043 - E3

FUMIGATION AND REUSE OF BROILER LITTER,

Hawaii Univ., Honolulu. Dept. of Animal Sciences.
Ernest Ross.
Poultry Science, Vol 47, 1968, p 1711-1712.

Descriptors: *Farm wastes, *Poultry, *Fumigants, Broods, Performance, Mortality, *Waste treatment.
Identifiers: Weight gains, Feed conversion, Reused litter, Litter, Methyl bromide.

A series of experiments was conducted to compare the performance of broiler chicks reared on fresh and reused wood shavings litter. In addition, the effect of methyl bromide fumigation of reused litter on subsequent chick growth, feed conversion and mortality was studied. Non-fumigated fresh and reused litters served as controls. Methyl bromide fumigation reduced the total bacterial population of reused litter. This reduction, however, did not result in any significant improvement in body weight gains, feed conversion or mortality. The performance of the chicks reared on the fumigated litter was similar to that of chicks reared on reused litter and slightly superior to that of chicks reared on fresh wood shavings litter. The mortality of chicks reared on fresh litter was slightly lower than in the groups on the reused litters. (White-Iowa State)

0044 - B3, D4, E3

THE DIGESTION OF POULTRY FECES UNDER CAGES,

Auburn Univ., Ala. Dept. of Poultry Science.
J. R. Howes.
Poultry Science, Vol 47, p 1682, 1968.

Descriptors: *Farm wastes, *Poultry, *Aerobic conditions, Odor, Aerobic bacteria, Fertilizer, Nitrogen, Stabilization, *Waste treatment.
Identifiers: *Absorbent substrate, *Cage operation, *Inoculation, Control plots.

A series of small experiments were carried out under cages with and without concrete floors, using various absorbent substrates for poultry feces. After an initial buildup period, the feces and substrate was inoculated with aerobic bacteria and aerobic conditions maintained by disturbing the surface cake at intervals. These experiments led to a field trial without any absorbent substrate at a large cage operation in south Florida, which has now been in operation for 18 months. Odors and flies have been largely eliminated except in control plots and spraying for fly control greatly reduced. The bulk of the fecal pile was less than half the volume of the control plots due to stabilization of nitrogen and water losses. Feathers were digested if they were incorporated into the fecal pile and the resulting material was a homogenous, odorless fertilizer which has been used in urban gardens and on golf greens. (White-Iowa State)

0045 - C5

THE POTENTIAL DIGESTIBILITY OF CELLULOSE IN FORAGE AND FAECES,

University of New England, Armidale (Australia). Dept. of Agronomy.
R. J. Wilkins.
Journal of Agricultural Science, Vol 73, No 1, 1969, p 57-64. 1 fig, 6 tab, 35 ref.

Descriptors: *Farm wastes, *Cellulose, *Digestion, *Incubation, Grasses, Forages, Sheep, Nitrogen, Carbohydrates, Organic matter, Analytical techniques.
Identifiers: *Potential digestibility, *Digestibility coefficients, *Cellulose digestibility, Duration of digestion, Rumen, Ryegrass, Cocksfoot, Callide Rhodes grass, Samford Rhodes grass, Lignified and cutinized tissue.

The potential digestibility of cellulose is defined as the maximum digestibility obtainable when the conditions and duration of digestion are not limiting factors. Techniques for measuring potential cellulose digestibility were examined and the relationship between potential digestibility and in vivo cellulose digestibility was explored for a range of grasses. Cellulose digestibility was found to reach a maximum value after 5 days incubation in vitro. No further cellulose was digested when the residues from an initial incubation for 6 days were incubated with a second rumen liquor inoculum. The values measured after a single incubation of 6 days duration were similar to cellulose digestibility coefficients measured by the suspension of ground forage samples in nylon bags in the rumen for 6 days. Plant factors appear to limit further digestion and the residue from prolonged digestion in vitro consisted only of lignified and cutinized tissue. Potential cellulose digestibility measured by either of the above techniques was higher than cellulose digestibility in vivo. The difference varied between forages and when the difference was large, the digestibility of cellulose in faeces was high. It is suggested that measurements of the potential digestibility of cellulose in feed and faeces may be of use in estimating the digestibility of grazed herbage. (White-Iowa State)

0046 - A5, A10, F3

FARM WASTE DISPOSAL-AMENITY AND GOOD NEIGHBOURLINESS,

K. B. C. Jones.
Great Britain Ministry of Agriculture, Vol 77, No 4, p 165-167, April 1970.

Descriptors: *Farm wastes, *Odor, *Water pollution, *Building codes.
Identifiers: *Noise, *Nuisances, *Legal action, Solid refuse.

A general picture of waste pollution in England's country side is shown by comparing today's production and disposal with that of yester-year's. Nuisances that are annoying to both farmers and city-dwellers are described. The rights and liabilities of both farmer and city-dwellers are outlined. (Miner-Iowa State)

0047 - F4

PRINCIPLES AND PRACTICES OF BEEF CATTLE FEEDLOTS,

Queensland Univ., Brisbane (Australia). Dept. of Animal Husbandry.
W. J. Pryor.
Australian Veterinary Journal, Vol 46, No 4, April 1970, p 173-177. 2 tab, 1 fig, 17 ref.

Descriptors: *Cattle, *Animal diseases, *Costs, Profit, Nutrient requirements, Silage, Sorghum, Wheat, Performance, Water pollution control.
Identifiers: *Feedlots, Feelot management, Feeding systems, Green chop.

It is believed the emergence of a large feedlot industry will be dependent primarily on two factors, the first being the availability of cheap feed and the availability of store cattle at a price which will permit a margin after they have been lot fattened, and the other, the introduction of a satisfactory national system of carcass grading and identification. A description is given of the principles involved in the management of feedlots with special reference to conditions operating in northern Australia. The importance of concentrate to roughage ratios and protein and mineral requirements are stressed. Diseases have played only a minor part in feedlot management in Australia thus far, and it is suggested that the veterinarian can play a more useful role in supplying sound advice on economic feeding and management. (White-Iowa State)

0048 - E2

SOIL FERTILITY UNDER CONTINUOUS CULTIVATION IN NORTHERN NIGERIA. I. THE ROLE OF ORGANIC MANURES,

R. G. Heathcote.
Experimental Agriculture. Vol 6, No 3, p 229-237, 1970. 13 tab, 14 ref.

Descriptors: *Trace elements, *Limiting factors, Farm wastes, Fertilizers, Crop response, Deficient elements.
Identifiers: Organic fertilizers, Nigeria, Organic manures.

Soil acidity, incipient potassium deficiency, and a deficiency of one or more trace elements were limiting factors in three trials of long-term soil fertility changes under continuous cultivation in the Sudan Savanna zone of Nigeria. The effectiveness of organic manures is explained largely or wholly in terms of these factors, since no evidence has yet been found to suggest that the addition of organic matter as such is of value. (Christenbury-Iowa State)

0049 - D4, E2

USE OF SOIL TO TREAT ANAEROBIC LAGOON EFFLUENT RENOVATION AS A FUNCTION OF DEPTH AND APPLICATION RATE,

Iowa State Univ., Ames. Dept. of Agricultural Engineering.
J. K. Koelliker, and J. R. Miner.
Transactions of the American Society of Agricultural Engineers, Vol 13, No 4, p 496-499, July-August 1970. 3 fig, 4 tab, 19 ref.

Descriptors: *Denitrification, *Nitrogen, *Irrigation, Farm wastes, Chemical oxygen demand, Lagoons, Nitrates, Nitrites, Ammonia, Bacteria, Treatment, Disposal, Anaerobic conditions, Waste water treatment.
Identifiers: *Nitrogen balance, Nitrobacter, Nitrosomonas, Lagoon effluent, Application rates.

This paper reports the findings from a study where lagoon effluent was applied to soil for final treatment. The active soil profile appears to offer great potential as a final treatment media for partly treated animal wastes. Anaerobic livestock-lagoon effluent sprinkled on grass-covered soil profile reduced the COD, phosphorous, and nitrogen concentrations 95, 99, and 80 percent, respectively in 3 months. Loading range was 13.9 to 30.5 in. of lagoon effluent. Removal of COD was attributed to biological activity and physical filtration in the upper inches of soil. Phosphorus reduction resulted from chemical activity of the clay fraction near the soil surface. Nitrogen reduction was attributed primarily to dentrification in the soil profile. It was recommended that if nitrogen reduction is a goal in waste water disposal, a rather wet schedule should be followed. The applied waste water should contain some organic load so that a substrate will be provided for the denitrifying bacteria. (Christenbury-Iowa State)

0050 - B1, F4

TREATMENT AND DISPOSAL OF ANIMAL WASTES,

Cornell Univ., Ithaca, N.Y.
Raymond C. Loehr.
Industrial Water Engineering, Vol 7, No 11, p 14-18, November 1970. 3 fig.

Descriptors: *Farm wastes, Lagoons, Drying, Nutrients, Disposal, Inorganic compounds, Nitrogen, Phosphorus, Nitrification, Denitrification, Confinement pens, Waste water treatment.
Identifiers: Holding tanks, In-house ditches, Oxidation ditches, Separation of wastes, Composting System.

Due to confinement feeding of livestock it has become doubtful from the profit standpoint to recycle manure by applying it to land. There has been an increase of 120% in the number of cattle of feed in the last 15 years. Laws are being considered which make it mandatory to reduce the pollution potential of livestock waste. The nine most feasible systems for animal waste disposal are discussed. These systems utilize either holding tanks, in-house ditches, separation of wastes, or drying and composting. These systems will remove most of the organic-oxygen-demanding material but not the inorganic nutrients. Land disposal has been effective for disposal of phosphorous. However land disposal for nitrogen may not be adequate. Two techniques for reducing the nitrogen load in animal waste is through ammonia release and the nitrification-denitrification cycle. (Christenbury-Iowa State)

0051 - A3

IMPACT OF AGRICULTURAL POLLUTANTS ON WATER USES,

Robert S. Kerr Water Research Center, Ada, Okla.
James P. Law, Jr., and Harold Bernard.
Transactions at the American Society of Agricultural Engineers, Volume 13, No 4, p 474-478, July-August 1970. 3 tab, 23 ref.

Descriptors: *Farm wastes, *Irrigation, *Salinity, *Pollutants, *Fertilizers, *Water pollution sources, Biochemical oxygen demand, Chemical oxygen demand, Disposal, Livestock, Agricultural chemicals, Aquatic life, Water quality, Fish, Dissolved oxygen, Aesthetics, Recreation, Pollutant identification.
Identifiers: *Agricultural pollutants, *Aesthetic value, Total salt, Primary contact recreation, Secondary contact recreation.

This paper discussed the water pollution potential of agricultural sources. Animal wastes, irrigation return flows, fertilizer application, and pesticides are the primary sources of agricultural pollutants. The water-quality criteria for water supplies are discussed as related to agricultural contaminants. Data is presented for the desirable and permissible limits of concentration for the various contaminants. Agricultural is responsible for a major portion of the total salt in many rivers and streams. Data is given for the proposed safe limits of water salinity for livestock. The impact that agricultural pollutants has on fish, other aquatic life, and wildlife is discussed. Examples are cited where pollutants have adversely affected fish and wildlife. Now is the time to build the cost of clean water into all of our operations. (Christenbury-Iowa State)

0052 - A4, C3

NITROGEN CONTAMINATION OF GROUNDWATER BY BARNYARD LEACHATES,

Guelph Univ. (Ontario). Dept. of Soil Science.
R. W. Gillham, and L. R. Webber.
J Water Pollut Contr Federation, Vol 41, No 10, p 1752-1762, Oct 1969. 11 p, 10 fig, 2 tab, 13 ref.

Descriptors: *Farm wastes, *Cattle, *Leaching, *Water pollution sources, Path of pollutants, Water pollution effects, Nutrients, Groundwater movement, Nitrogen, Waste water (Pollution).
Identifiers: Cattle wastes, Feedlot wastes.

A zone of nitrogen-contaminated groundwater associated with a barnyard was studied to determine the quantity of inorganic nitrogen reaching the groundwater from the barnyard. From piezometric potential and hydraulic conductivity measurements, quantitative flow nets were drawn permitting groundwater discharge calculations. An increase from 2 to 15 mg/l inorganic nitrogen occurred in the groundwater as it passed beneath the barnyard. This resulted in a contribution of 4.4 lb (2.0 kg) of inorganic nitrogen made by the barnyard to the groundwater during the 5-month study period. The concentration of nitrogen was related to the direction of groundwater flow and was dependent on the presence of conditions suitable for the leaching of nitrogen and the dilution potential of the local groundwater flow system. The surface topography proved to be a poor indication of the direction of groundwater flow. (Knapp-USGS)

0053 - B3

FARMYARD MANURE HANDLING.

Ministry of Agriculutre, Fisheries and Food, London (England).

Mechanization Leaflet For Farmers and Growers, No 8, December 1965. 6 p.

Descriptors: *Farm waste, *Disposal, *Equipment, Operations, Waste water treatment.
Identifiers: *Machinery, *System, Loaders, Spreaders, Scrapers, United Kingdom.

This leaflet describes the more important types of equipment and working methods used at present in the United Kingdom for farmyard manure handling. Loading and spreading equipment are discussed. Recommendations are made as to the most efficient methods of combining the available men and equipment into an operating system for manure disposal. (Christenbury-Iowa State)

0054 - A1, F4

POLLUTION POTENTIAL OF LIVESTOCK FEEDING OPERATIONS IN SOUTH DAKOTA,
South Dakota State Univ., Brookings. Dept. of Civil Engineering.
James N. Dronbush.
Sponsored by the SDSU College of Agriculture and Biological Sciences, and the College of Engineering. Proceedings South Dakota Agriculture and Water Quality - A Symposium on Water Pollution, 1970, p 37-46, 4 tab, 3 fig.

Descriptors: *South Dakota, *Runoff, *Pollutants, Farm wastes, Lagoons, Cost sharing, Locating, Cattle.
Identifiers: *Pollution potential, *Population equivalents, Feedlots.

The overall pollution problem for livestock feeding operations may not be as critical in South Dakota as has been assumed. Certain climatic factors appear favorable, nevertheless, feedlots poorly locited with excessive drainage may be expected to cause problems especially to lakes. General prinicples are available as guide lines for construction to control pollution and cost sharing is available. Although research can be expected to provide greater related knowledge, there appears to be little excuse for delaying the program of active feedlot pollution control particularly with all planned new construction for expansion of the feeding industry. (Christenbury-Iowa State)

0055 - F4

MISSION IMPOSSIBLE: DISPOSE ANIMAL WASTES,
Ohio State Univ., Columbus. Dept. of Agricultural Engineering.
E. Paul Taiganides.
Purdue University, Engineering Extension Service, Bulletin No 135, p 542-549, 1969. 1 fig, 4 tab, 10 ref. (Proceedings 24th Industrial Waste Conference).

Descriptors: *Transportation, *Disposal, *Management, Farm wastes, Lagoons, Production, Anaerobic digestion, Aerobic treatment, Biochemical oxygen demand, Gases, Dehydration, Odor.
Identifiers: *Generation, *Processing, *Utilization, Waste management, Anaerobic lagoons, Gas production, Composting.

The development of a 'waste management technology' analogous to the new patterns of animal production and in harmony with our need to keep our natural resources from being polluted is not an impossible mission but rather a challenging mission whose resolution is requiring of engineers and scientists the same ingenuity that has been shown in developing modern methods of production of consumer goods. This paper discusses the changes and trends in the components of animal waste management. The discussion is divided into five areas: waste generation, waste transportation, waste processing, waste utilization and waste disposal. (Christenbury-Iowa State)

0056 - D4

PRELIMINARY RESULTS OF A NOVEL BIOLOGICAL PROCESS FOR TREATING DAIRY WASTES,
Allis-Chalmers Manufacturing Co., Milwaukee, Wis.
Ronald L. Antonie, and Fred M. Welch.
Purdue University, Engineering Extension Service, Bulletin No. 135, p 115-126, 1969. Proceedings 24th Industrial Waste Conference.

Descriptors: *Equipment, *Aerobic conditions, *Biological treatment, *Biomass, Farm wastes, Aeration, Microorganisms, Biodegradation, Chemical oxygen demand.
Identifiers: *Loading rate, Rotating Biological Contractor, Field test.

Field testing of a device called the 'Rotating Biological Contractor' or 'RBC' is the subject of this paper. The device consists of a series of discs which are mounted on a shaft and rotated while partially submerged in the waste to be treated. A microbial film develops on the surface of the discs. The rotation of the discs carry the microorganisms into the air for aeration so that they can carry on aerobic activity. The field tests have shown that the RBC can effectively treat waste from a dairy plant. Varying weather conditions have no apparent effect on RBC effectiveness. RBC characteristics of a large microbial population, flexible aeration capacity, little maintenance, low power requirements and predictable performance make the RBC an attractive process for biological treatment of dairy wastes. (Christenbury-Iowa State)

0057 - A5, A6, B1

THE MENACE OF NOXIOUS GASES IN ANIMAL UNITS,
Ohio State Univ., Columbus. Dept. of Agricultural Engineering.
E. Paul Taigonides, and Richard K. White.
Transactions of the ASAE, Vol 12, No 3, 1969, p 359-362, 367. 2 tab, 18 ref.

Descriptors: *Farm wastes, *Gases, *Effects, Carbon dioxide, Oxygen, Ammonia, Hydrogen sulfide, Methane, Lethal limit, Toxicity, Cattle, Hogs, Poultry, Ventilation, Treatment.
Identifiers: *Concentrations, Storage pits, Pit cleaning, Lethal situations.

The paper begins with a description of noxious gases and it is noted that animal deaths have occurred as the result of an accumulation of these gases. The gases, their properties and characteristics listed, are carbon dioxide, ammonia, hydrogen sulfide, methane, and other gases. Oxygen is listed to show its indispensability inside a confinement building. Animal response to menacing concentrations of these gases is described. A table lists different properties of the noxious gases and their physiological effects on the animals. Possibly fatal concentrations are noted, along with the potentially lethal situations which may bring about these concentrations. Among these situations are ventilation breakdowns, pit stirring and pit cleaning. Finally, the control of noxious gases is emphasized. Preventive measures, moderating the effects of noxious gases, and treatment of affected animals are all discussed. (White-Iowa State)

0058 - B2, E3

REUSE OF WASH WATER FOR CLEANING CAGED LAYER HOUSES,
North Dakota State Univ., Fargo. Dept. of Agricultural Engineering.
R. L. Witz, G. L. Pratt, and J. L. Sell.
Transactions of the ASAE, Vol 12, No 6, p 807-812, November 1969. 7 fig.

Descriptors: *Recirculated water, Farm wastes, Poultry, Storage tanks, Equipment, Odor.
Identifiers: Flushing gutters, Manure.

A liquid manure handling system was designed for a poultry house. Manure is collected in concrete gutters beneath the cages. A flushing process is used to clean the gutters. A wooden scrape is forced down the length of the gutter by pressure exerted by water that had been added behind the scrape. The water was collected in an outside pit for reuse. This system has been effective for reducing the total quantity of water required for cleaning the poultry house. (Christenbury-Iowa State)

0059 - F4

THE MANAGEMENT OF LIVESTOCK MANURE,
California Univ., Davis. Dept. of Agricultural Engineering.
S. A. Hart.
Transactions of the ASAE, Vol 3, p 78-80, 1960. 4 fig, 1 tab, 13 ref.

Descriptors: *Farm wastes, *Disposal, *Management, Storage, California, Dehydration, Livestock, Fertilizers, Value.
Identifiers: *Composting, *Sanitation, Processing, House fly, Musca domestica, Carbon to nitrogen ratio, Production.

Manure management will seldom be a profit-making part of the farming enterprise. In most cases the cost of proper handling will exceed the value of the manure as a fertilizer or soil amendment. Even so, manure handling is as necessary a chore as is feeding or animal care. Through proper manure management the net cost of handling the manure can be minimized and the sanitation requirements of the farming operation fulfilled. The procedures of systems engineering are applicable to the management of livestock manure, and can be stated as the specific operations of: (a) gathering and cleaning up the manure, (b) storing or processing it, and (c) utilizing [illegible] disposal of it. (Christenbury-Iowa State)

0060 - A4, F3

RELATION OF AGRICULTURE TO GROUNDWATER POLLUTION: A REVIEW,
North Carolina State Univ., Raleigh.
J. W. D. Robbins, and G. J. Kriz.
Trans Amer Soc Agr Eng, Vol 12, No 3, p 397-403, May-June 1969. 7 p, 2 tab, 97 ref.

Descriptors: *Agricultural engineering, *Groundwater, *Pollutants, *Farm wastes, Agriculture, Pollution abatement, Farm management, Waste water (Pollution), Pesticides, Insecticides, Herbicides, Bibliographies, Saline water, Irrigation water, Waste water disposal, Waste disposal, Water pollution, Water pollution control, Water Pollution sources.
Identifiers: Groundwater quality, Pollution control.

Groundwater is a water resource and a potential medium for receiving wastes. Agricultural enterprises produce wastes that can lead to rapid degradation of groundwater. Agricultural engineers are responsible for evaluating agricultural groundwater pollution problems and recommending control and abatement measures. The purpose of this paper is to orient agricultural engineers on groundwater pollution problems caused by agricultural practices in 3 general areas: (1) evaluation of groundwater as a receiving medium for agricultural wastes, (2) characterization of the source of the pollutants, and (3) delineation of the types of solutions needed for agricultural groundwater quality problems. Agricultural groundwater pollutants reviewed are animal wastes, fertilizers, pesticides, plant residues, and saline waste water. (USBR)

0061 - A3

SURFACE RUNOFF AND NUTRIENT LOSSES OF FENNIMORE WATERSHEDS,

Wisconsin Univ., Madison. Dept. of Agricultural Engineering. State of Wisconsin.
S. A. Witzel, Neal F. Minshall, M. Starr Nichols, and John Wilke.
Transactions of the ASAE, Vol 12, No 3, 1969, p 338-341. 4 tab, 3 fig, 5 ref.

Descriptors: *Surface runoff, *Nutrients, Fertilizers, Farm wastes, Nitrogen, Phosphorus, Potassium, Wisconsin, Agricultural watersheds, Discharge, Soils, Topography, Geology, Cover crops, Weirs, Precipitation, Snow.
Identifiers: *Runoff sampler, Fennimore, Wisconsin.

The paper describes the soils, geology, topographic features and cover of a 330 acre watershed near Fennimore, Wisconsin. The watershed was subdivided and wiers were placed with semi-automatic runoff samplers to sample winter runoff water. The amount of commercial fertilizer as well as manure that was applied was determined. The runoff samples were analyzed and the amount of nutrients lost was calculated from the wier calibration. The amount of runoff during the winter of 1967 was about twice the 29 year average. The nutrients lost in surface runoff were much greater than those in the base flow of southwestern Wisconsin streams. In a year of average runoff, assuming nutrient losses directly proportional to runoff, the losses would be 2 lb. nitrogen, 0.6 lb. phosphorus and 4 lb. potassium per acre. (White-Iowa State)

0062 - A2, B1, D1

MANAGEMENT OF CATTLE FEEDLOT WASTES,

Iowa State Water Resources Research Inst., Ames.
Richard R. Dague, and Kenneth J. Kline. Iowa State Water Resources Research Institute Report No 69-4, Iowa University, Project Completion Report, June 30, 1969. 195 p, 99 fig, 20 tab, 19 ref, 4 append.

Descriptors: *Farm wastes, *Confinement pens, *Waste treatment, *Waste disposal, Lagoons, Water pollution control, Water pollution sources.
Identifiers: Feedlot wastes, Waste management.

The effects of hydrologic factors on the control of runoff from open feedlots were studied. Management and treatment techniques are discussed and evaluated. Rainfall, runoff, and streamflow are the primary factors to consider in managing cattle feedlot runoff. The nature, volume, and rate of delivery of runoff are directly related to rainfall. Storage requirements depend upon the volume of runoff, whereas the retention pond discharge rate should be proportional to streamflow. Terraces and retention ponds will reduce the pollution from cattle feedlot runoff. Application to land appears to be the most practical method of disposal for both the solids and the liquid. When applied to agricultural land, the waste has some economic value. Retention ponds may not remove sufficient amounts of suspended solids, BOD, COD, and nutrients to provide safe effluents for disposal to streams. (Knapp-USGS)

0063 - A3, A6, A7, A9

SOIL POLLUTANTS: THEIR ORIGIN AND BEHAVIOR,

Guelph Univ. (Ontario). Dept. of Microbiology.
D. E. Elrick, J. W. Biggar, and L. R. Webber.
Journal Soil Water Conservation, Vol 21, p 7-11, 1966. 3 fig, 26 ref.

Descriptors: *Pollutants, *Pesticide residues, *Degradation (Decomposition), Farm wastes, Pollutant identification, Effluents, Pesticides, Sewage, Domestic wastes, Disposal, 2-4-D, DDT, Chlorides, Radioactive wastes, Air pollution effects.
Identifiers: *Contaminants, Biological contaminants.

Pesticides, industrial and municipal wastes, radioactive materials, microbes, and other potential pollutants are coming in contact with our soils in ever increasing amounts. This article discusses certain sources of soil contaminants and outlines a few of the research techniques being used in an attempt to understand their behavior in soils. Agricultural chemicals may become harmful pollutants if improperly used. Sewage and industrial wastes make up the bulk of contaminating substances produced by our society. Waste disposal is related to biological contamination of water supplies by bacteria and viruses. Radioactive contamination and some air pollutants come into contact with the soil. The movement of some of the soil pollutants is discussed. (Christenbury-Iowa State)

0064 - C5

URINARY CREATININE AS AN INDEX COMPOUND FOR ESTIMATING RATE OF EXCRETION OF STEROIDS IN THE DOMESTIC SOW,

Purdue Univ., Lafayette, Ind.
R. E. Erb, S. A. Tillson, G. D. Hodgen, and E. D. Plotka.
Journal Paper No 3644, Purdue University Agricultural Experiment Station. Journal of Animal Science, Vol 30, No 1, p 79-85, January 1970. 5 tab, 20 ref.

Descriptors: Farm wastes, Urine, Hogs, Livestock, Animal physiology.
Identifiers: *Steroids, *Creatinine, Index compound.

During two experiments urine was collected form 36 yearling sows to estimate rate-of-excretion of creatinine and to evaluate its use as an index compound. Excretion rate averaged 205 mg/hr. and 1.35 mg/hr./kg live weight for Experiment I as compared to 201 mg/hr. and 1.38 mg/hr./kg live weight for Experiment II. Measurement of urine volume for 48-hr. allows estimation of creatinine excretion rate of sows with coefficients of variability of 7-8%. In comparison, the coefficients of variability were 18 and 13%, respectively, for 12-hr. and 24-hr. periods. These experiments show that the ratio, microgram steroid per mg urinary creaunine is an accurate method for expressing rate of excretion of steroids in urine. (Christenbury-Iowa State)

0065 - F4

AGRICULTURE POSES WASTE PROBLEMS.

Environmental Science and Technology, Vol 4, No 12, p 1098-1100, December 1970. 2 fig.

Descriptors: *Farm wastes, *Pollutants, *Wastes identification, *Environmental effects, Water pollution sources.
Identifiers: *High intensity farming, Contamination, Plant emissions, Government action.

Increasing concentration and intensity of agricultural activities necessary to the development and prosperity of the economy, are responsible for many new environmental issues. Primary sources of pollution resulting from agricultural practices can be grouped as: animal wastes, wastes from processing of raw agricultural products, rural domestic wastes, and sediment from land; also plant nutrients from fertilizers, inorganic salts and minerals resulting from irrigation, pesticides, aeroallergens and infectious agents contribute to the problem; particulate and gaseous substances derived from the combustion of wastes and natural plant emmissions add to the problem. A brief description of these sources and some possible solutions are presented. (Christenbury-Iowa State)

0066 - B2, C2, D4

THE EFFECTS OF VOLUME AND SURFACE AREA ON THE RATE OF ACCUMULATION OF SOLIDS IN INDOOR MANURE DIGESTION TANKS,

Nebraska Univ., Lincoln.
Ali A. Al-Timimi, W. J. Owings, and John L. Adams.
Poultry Science, Vol 44, p 112-115, 1965. 3 tab, 4 ref.

Descriptors: *Farm wastes, *Poultry, *Digestion tanks, Volume, Least squares method, Overflow, Lagoons, Waste treatment.
Identifiers: *Surface area, Dry matter, Hen weight, Feed consumption, Egg weight.

Ten stainless steel tanks were utilized to form four volume and two surface area allowances. Leghorn type pullets were placed in eight inch cages over the tanks and their manure was allowed to accumulate in liquid for 20 weeks. At the end of each 2 week period, dry matter determinations were made and hen weight, feed weight and egg production were recorded. The dry matter percentages were put on a 3.5 cu. ft/bird basis and the changes in per cent dry matter from one period to another were calculated. Cubage and surface area per bird seemed to have no significant effects on the rate of digestion of the solids in the tanks. Periods and the interaction between treatments and periods were highly significant. Although the manure output is influenced by factors such as hen weight, feed consumption and egg weight, none of these factors showed any significant effect, because of the uniform distribution of the hens assigned to the treatments. Liquid overflow was inversely related to the surface area per bird. At least 3.5 cu. ft of water per bird is needed to provide for biennial cleaning. (White-Iowa State)

0067 - B1, D1

EFFLUENT DISPOSAL - STILL A MAJOR PROBLEM,

Wright Raine Ltd.
W. T. A. Rundle.
Journal and Proceedings of the Institution of Agricultural Engineers, Vol 21, p 134-139, 1965. 5 fig, 5 tab.

Descriptors: *Farm wastes, *Slurries, Sludge, Sprinkler irrigation, Pumping, Storage tanks, Labor, Volume, Rates of application.
Identifiers: *Field spreading, Vacuum tanks, Mechanical agitation.

Equipment and methods of manure disposal used in handling manure slurries are described. The equipment is broadly divided into two categories including mobile trailer type equipment and pumping equipment. Several examples of each are given. Tables list the waste production and labor required for each system as a function of volume handled. A digester is also described, which reduces the volume of material put in by 20%, and produces a sludge with no smell. It is suggested that the cost of this operation would be prohibitive. A discussion follows centering on problems and solutions to problems which have arisen from the systems discussed. (White-Iowa State)

0068 - B1, F2

POSSIBLE DEFENSES AGAINST NUISANCE COMPLAINTS,

Illinois University.
H.W. Hannah.
Poultry Digest, p. 601, December 1970.

Descriptors: *Legal aspects, farm wastes, poultry.
Identifiers: Nuisance complaints.

H.W. Hannah has outlined six possible defenses that may be used by poultrymen against nuisance complaints. These include that the plaintiff is oversensitive and/or does not have the facts correct. The poultryman may claim that he was there first and/or that the area is zoned for agricultural use. The poultryman may claim that he has considerable investment in the operation. The poultryman may claim that the conditions will improve if granted additional time. (Christenbury-Iowa State)

0069 - B2, E2, F2

CONNECTICUT REQUIREMENTS FOR LIQUID MANURE DISPOSAL,
Connecticut Public Health Department

Poultry Digest, December 1970, p. 583.

Descriptors: *Connecticut, *regulation, *liquid wastes, farm wastes, pollutants, wastes disposal, water pollution.
Identifiers. Liquefied manure.

The Connecticut Public Health Department has set forth requirements that poultrymen and others must follow. Liquefied manure should be spread on level fields so that it does not come within 200 feet of any watersupply. No liquefied manure should be applied to frozen or snow-covered ground. No liquid manure should be applied when ground is saturated with rainfall or groundwater. No more than 5,000 gallons of liquid manure per acre should be applied at any one time. The fields should be given a rest period so that digesting of organic material can occur in the soil. (Christenbury-Iowa State)

0070 - E2

SOILS AS AN ANIMAL WASTE DISPOSAL MEDIUM,
Minnesota Univ., St. Paul. Dept. of Soil Science.
William P. Martin.
Journal of Soil and Water Conservation, Vol 25, p 43-45, March-April 1970. 18 ref.

Descriptors: *Farm wastes, *Soils, Nitrogen, Phosphorous, Potassium, Soil water, Water pollution, Soil contamination, Soil surveys, Nutrients, Fertilizers, Soil properties, Value, Soil chemical properties, Soil physical properties, Soil erosion, Sedimentation, Minnesota.
Identifiers: Waste disposal medium.

Pollution of the soil-water complex occurs mostly because we have no other medium for waste disposal. The author discusses the various reactions which can be expected in soil with respect to nitrogen, phosphorous and potassium. The importance of erosion and sedimentation control is also pointed out. It was stressed that considerable additional information is needed if we are to maximize the use of the soil as a waste disposal medium in such a way as to minimize pollution. We must manage our natural resources to accomodate our waste disposal needs with a minimum of pollution and still produce nutritious food in adequate amounts for our rapidly increasing population. (White-Iowa State)

0071 - A2, B1, C5

ENGINEERING ANALYSIS OF CATTLE FEEDLOTS TO REDUCE WATER POLLUTION,
Texas Technological Coll., Lubbock. Dept. of Civil Engineering.
W. Grub, R. C. Albin, D. M. Wells, and R. Z. Wheaton.
Transactions of the American Society of Agricultural Engineers, Vol 12, 1969, p 490-492, 495. 2 tab, 5 fig, 3 ref.

Descriptors: *Farm wastes, *Cattle, *Water pollution sources, Runoff, Precipitation, Nitrogen, Phosphorus, Biochemical oxygen demand, Slopes, Surfaces, Feeds, Silage, Management, Design, Waste water treatment.
Identifiers: *Feedlots, *Ration composition, Feedlot layout, Waste accumulation.

Incorporating both engineering and biological aspects, this report contains an analysis of data and suggests management and design practices that could reduce materially the pollution contributed by the confined land area where feeder cattle are maintained. The study was conducted in two phases. The first phase was concerned with the waste accumulation on the feedlot surface as influenced by ration. The second phase of the project was concerned with determining the quality of liquid runoff as related to the rations fed to cattle, as related to the time of accumulation of the manure pack. For the first phase, ration composition, its effect on quantity of excretion, and changes in the accumulated wastes are looked at. For the second phase, the effects of precipitation, surfacing material, land slope, depth of waste accumulation, feedlot layout, and ration composition are evaluated. Nitrogen, phosphorus and BOD were used as measures of pollution. (White-Iowa State)

0072 - E3

A NOTE ON THE UTILISATION BY CHICKENS OF ENERGY FROM FAECES,
Queensland Univ., Brisbane (Australia). Dept. of Animal Husbandry.
W. J. Pryor, and J. K. Connor.
Poultry Science, Vol 43, p 833-834, 1964. 2 tab, 2 ref.

Descriptors: *Farm wastes, *Poultry, Energy, Wheat, Sorghum, Nitrogen.
Identifiers: *Metabolizable energy, Bomb calorimeter, Ration.

Four groups of male chickens aged 22 days which had been on a trial to determine the metabolizable energy of grain sorghum, were allotted at random two to each treatment. Two groups were fed crushed grain sorghum. The remaining two groups were fed a ration consisting of 80% crushed grain sorghum mixed with 20% feces resulting from a previous wheat trial. All four rations contained a standard broiler mineral and vitamin supplement. The results showed that the feces had a metabolizable energy value of approximately 30% of the feed from which it originated. (White-Iowa State)

0073 - F2

STOCKMEN'S LIABILITY UNDER THE MISSOURI NUISANCE LAW,
Missouri Univ., Columbia.
Donald R. Levi, and John C. Holstein.
Science and Technology Guide, Published by the University of Missouri-Columbia Extension Division; File: Ag Econ 3 3/70, 7M. p 581-584, (Mar 1970).

Descriptors: *Legal aspects, *Regulation, Farm wastes, Missouri.
Identifiers: *Pollution laws, *Nuisance law, *Legal procedure, *Liability, Lawsuits, Stockmen.

There is no one thing a livestock operator can do and gain absolute protection under the nuisance law. Thus, it is imperative that you attempt to prevent such lawsuits from arising. This implies that those who follow a 'good neighbor' policy are less likely to be sued. Try to avoid causing your neighbors discomfort. This guide only discusses some general principles affecting the civil liability of feedlot operators under the nuisance laws. If you are faced with potential air or water pollution problem, don't hesitate to discuss it with your attorney. (Christenbury-Iowa State)

0074 - D4

AEROBIC DIGESTION OF SWINE WASTE,
Illinois Univ., Urbana. Dept. of Agricultural Engineering.
D. D. Jones, J. C. Converse, and D. L. Day.
Proceedings of CIGR (Commission Internationale du Genie Rural), p 204-211, 1969. 7 fig, 2 ref.

Descriptors: *Oxygenation, *Aeration, *Foaming, Biochemical oxygen demand, Farm wastes, Swine, Lagoon, Dissolved-oxygen, Aerobic treatment, Odor, Gases, Liquid wastes, Waste water treatment.
Identifiers: *Oxidation ditch, *Total solids, Loading rate, Defoaming agent, In-the-building treatment.

An oxidation ditch for in-the-building treatment of swine waste was evaluated. Odorless aerobic treatment could be obtained under the self cleaning slatted floors of a confinement building by connecting the ends of the liquid-manure gutters and adding a rotor aerator. The results indicate that loading rates of 6 cu. ft. or less per hog are not suitable for in-the-building, oxidation-ditch treatment. Loading rates of 8 cu. ft. per hog were most satisfactory. Oil was used as a defoaming agent when required. No foaming was encountered at loading rates higher than 8.5 cu. ft. per hog provided sufficient oxygen was supplied. The mixed-liquor, 5-day BOD of swine waste was reduced from 40,000 to 3,000 to 10,000 milligrams per liter. (Christenbury-Iowa State)

0075 - B1, C3, D4, F1

HOG WASTE DISPOSAL BY LAGOONING,
Illinois Dept. of Public Health, Springfield, Ill. Div. of Sanitary Engineering.
Charles E. Clark.
Journal of the Sanitary Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 91, No SA6, p 27-41, December 1965. 3 tab, 1 fig, 9 ref.

Descriptors: *Farm wastes, *Farm lagoons, Odor, Scum, Gases, Bubbles, Biochemical oxygen demand, Chemical oxygen demand, Coliforms, Sampling, Depth, Volume, Septic tanks, Dissolved oxygen, Costs, Nutrients, Chlorophyta, E. coli, Antibiotics, Nitrogen, Potassium, Phosphorus, *Hogs.
Identifiers: *Lagoon supernatant, Shock loading, Surface area, Farrowing house, Feeding house, Total solids, Volatile solids, Enterococcus, Penicillin, Algal population.

The material presented consists of on-site observations and test results obtained from samples collected from an operational farm lagoon in Illinois. The program centered on this lagoon since others around it had failed. The system itself is described and possible solutions given as to why it does work. Chemical properties of the lagoon supernatant and the raw waste are compared. On the basis of observations made during this program, the most likely problem will be process failure caused by antibiotic effect, temperature change or shock loading. Studies are underway concerning the harvesting and feeding of algae from the lagoon. Operational problems as well as costs are evaluated for the total system. Finally, a practical system is suggested for the disposal of hog wastes. (White-Iowa State)

0076 - A3, A4, C3

NITRATE AND OTHER WATER POLLUTANTS UNDER FIELDS AND FEEDLOTS,
Agricultural Research Service, Fort Collins, Colo. Soil and Water Conservation Research Div.
B. A. Stewart, F. G. Viets, Jr., G. L. Hutchinson, and W. D. Kemper.
Environmental Science and Technology, Vol 1, No 9, p 736-739, September 1967. 2 fig, 1 tab, 1 ref.

Descriptors: *Nitrogen, *Nitrates, *Farm wastes, Groundwater, Water pollution, Water table, Soils, Irrigation, Fertilizers, Precipitation, Corn, Hydraulic conductivity, Carbon, Oxidation-reduction potential, Alfalfa, Ammonium compounds, Colorado.
Identifiers: Feedlots, Soil cores, Groundwater pollution, South Platte.

Agriculture's effect on nitrate pollution of groundwater was investigated in the South Platte valley of

Colorado. The valley is intensively farmed and contains many concentrated livestock feeding operations. A water table, generally between 3 and 20 meters below the surface, underlies much of the area. The average total nitrate-nitrogen to a depth of 6.7 meters in the profiles for the various kinds of land use was: alfalfa (13 cores), 70; native grassland (17 cores), 81; cultivated dry land (21 cores), 233; irrigated fields not in alfalfa (28 cores), 452; and feedlots (47 cores), 1282 kg. per hectare. Groundwater samples often contained high concentrations of nitrate, and those obtained beneath feedlots contained ammonium-nitrogen and organic carbon. (White-Iowa State)

0077 - B1, F4

FARM WASTE DISPOSAL IN RELATION TO CATTLE,
National Agricultural Advisory Service, London (England)
J. Gibbons.
Water Pollution Control, Vol 67, No 6, 1968, p 622-626, 2 tab, 4 ref.

Descriptors: *Disposal (Wastes), *Waste treatment, *Cattle, *Livestock, *Farm wastes, Costs, Silage, Effluent, Economic impact, Digestion, Drains, Groundwater, Streams, Buildings, Construction.
Identifiers: *Farm waste disposal, *Farm waste production, *Cow cubicles, *Dry-land farm, *Silage effluent, *Wet farms, Population equivalents of farm waste, Farming patterns, Solid systems, Organic irrigation, Slurry handling, Cubicle-housing/law labour system, Storage.

Changes in the pattern of farming and consequent effects on the nature of manure disposal problem on farms are discussed. Modern systems of dairy farming, including the special impacts of widespread production of silage, and the growth of the cubicle system of housing are examined. The consequent effluent disposal problems are evaluated. Design of disposal systems must take into account animal waste quantity estimates and the population equivalents of these farm wastes. Also, a vital factor in design requirements is evaluation of the changing patterns of farming. Waste treatment and disposal are discussed from the viewpoints of solid systems, handling organic irrigation methods, and slurry handling methods. The factors affecting storage requirements and capacities are analyzed. An important consideration in most systems is to keep the volume of contaminated liquid to a minimum and this is a vital factor in building design. Silage effluent treatment is given special attention because of the serious pollution problem which it can create. Special efforts are required to keep silage effluent from entering drains, streams, or groundwaters. Proper system design must consider land use, the type of existing facilities, the scale of enterprise, and type of livestock. Economic and technical considerations jointly should underlie the final design decisions. (D'Arezzo-Texas)

0078 - D4

OXYGENATION CAPACITIES OF OXIDATION DITCH ROTORS FOR CONFINEMENT LIVESTOCK BUILDINGS,
Illinois Univ., Urbana. Dept. of Agricultural Engineering.
Don D. Jones, Donald L. Day, and James C. Converse.
Purdue University, Engineering Extension Service, Bulletin No. 135, p 191-208. 12 fig, 5 ref. Proceedings 24th Industrial Waste Conference.

Descriptors: *Dissolved oxygen, *Oxygenation, Farm wastes, Equipment, Odor, Mass transfer, Theoretical analysis.
Identifiers: *Oxidation ditch, Alpha factor.

The oxidation ditch is one of the most successful methods for treating the staggering volume of animal manure that is being produced at the present time. The purpose of this paper is to present the oxygenation capacities of five aeration rotors tested at the University of Illinois. The rotors were tested in actual field installations with clean tap water in the ditch and the livestock removed. The parameter studies were blade immersion, blade design, rotor speed, and gross power requirements. There is little or no difference in oxygenation capacities between the angle iron bladed rotor and the rectangular plate rotor. The increase in oxygenation capacity is almost linear with depth of immersion or rotor speed. (Christenbury-Iowa State)

0079 - A3, C3

SOURCES OF NITROGEN AND PHOSPHORUS IN WATER SUPPLIES - TASK GROUP REPORT,

Journal of the American Water Works Association, Vol 59, p 344-366, March 1967. 8 tab, 1 fig, 64 ref.

Descriptors: *Nitrogen, *Phosphorus, Farm wastes, Eutrophication, Great Lakes, Distribution, Fertilizers, Ammonia, Nitrates, Nitrites, Phosphorus, Compounds, Domestic wastes, Detergents, Industrial wastes, Nutrients, Fuels, Water treatment, Rivers, Runoff, Drainage water, Sediment transport, Cultivated lands, Water fowl, Atmosphere, Rainfall, Nitrogen fixation.
Identifiers: *Fertilizer consumption, Concentrations, Urban runoff, Dustfall, Historical trends.

The results of this survey have indicated that nitrogen and phosphorus nutrients are contributed to water in significant quantities from a variety of man-made and natural sources. Data taken from a small scale were extrapolated to large areas of the country. This brings attention both on the sources of most significance as well as on the sources for which additional information is most needed. The estimation of nutrient contributions from various sources is presented in tabular form. The complete elimination of nitrogen and phosphorus nutrients from surface water supplies does not appear economically feasible because the sources are so widespread. Therefore, appropriate efforts must be made to cope with many of the problems that have been created, and increased effort must be devoted to the development of better methods for prevention of algal growth in reservoirs. A more concentrated effort by the water utility profession to reduce the detrimental effects caused by eutrophication of water supplies is recommended. (White-Iowa State)

0080 - C2

FLOW PROPERTIES OF ANIMAL WASTE SLURRIES,
Pennsylvania State Univ., University Park.
Mahesh Kumar, H. D. Bartlett, and N. N. Mohsenin.
Paper presented at the 1970 winter meeting American Society of Agricultural Engineers, Chicago, Dec 8-11, 1970, Paper No 70-911. 28 p, 7 fig, 2 tab, 26 ref.

Descriptors: *Slurries, *Viscosity, *Viscometers, Farm wastes, Viscous flow, Temperature, *Flow characteristics, Moisture content, Shear strength.
Identifiers: Shear diagrams, Flow behavior indices, Dilution, Pseudoplastic flow, Apparent viscosities, Newtonian fluids, Total solids.

The flow properties of animal waste slurries were studied with the use of a coaxial cylinder-type viscometer to determine shear diagrams, flow behavior indices, viscosity indices and apparent viscosities in relation to dilution, temperature and sawdust bedding content of the slurries. The viscosity of manure slurry decreases with increase in dilution. Flow is Newtonian for total solid content below five per cent. Addition of sawdust decreases the viscosity of slurries. Viscosity of fresh manure decreases with increase of temperature. Manure slurry of four to six percent total solids content is a good compromise between excessive volume of handling and power requirement. (Christenbury-Iowa State)

0081 - B1, C3, C5, E2

DISTRIBUTION OF ARSENIC FROM POULTRY LITTER IN BROILER CHICKENS, SOIL, AND CROPS,
Salsbury Labs., Charles City, Iowa. Dept. of Biochemistry.
Joseph L. Morrison.
Journal of Agricultural and Food Chemistry, Vol 17, p 1288-1290, November 1969. 5 tab, 27 ref.

Descriptors: *Arsenic, *Farm wastes, *Poultry, Soil, Crops, Assay, Alfalfa, Clovers, Correlation analysis, Groundwater, Pesticides.
Identifiers: *Poultry litter, *Arsenical feed additives, Hydrolized feather meal, Poultry tissue, Roxarsone.

The effect of the presence of organoarsenicals from feed additives in poultry house litter was investigated with respect to the distribution of arsenic in chickens raised on this litter, to the distribution of arsenic in soil fertilized with this litter, and to the distribution of arsenic in crops raised on soil fertilized with this type litter. Although measurable amounts of arsenic (15-30 ppm) were found in the litter, the arsenic content of soil and crops was unaffected by the use of poultry litter as fertilizer. Similarly, the arsenic content of birds was unaffected when raised on this type litter. (White-Iowa State)

0082 - C4, E4

HOUSE FLY PUPAE AS FOOD FOR POULTRY,
Agricultural Research Service, Beltsville, Md.
C. C. Calvert, R. D. Martin, and N. O. Morgan.
Journal of Entomology, Vol 62, No. 4, August 1969, p 938-939, 2 tab, 2 ref.

Descriptors: *Waste disposal, *Organic matter, Proteins, Poultry, Foods, Nutrients, Soybeans, Laboratory tests.
Identifiers: *House flies, Pupae, Fats, Waste utilization.

A study was conducted as a part of the waste utilization program to determine if the larvae of the house fly could be used to produce protein and fat from human wastes. Due to the difficulty of collecting sufficient larvae for this experiment, fly pupae were used. Pupae were obtained from a culture that had been maintained at the Beltsville Fly Control Laboratory for 60 generation and held at -10LC until needed. The pupae were dried, ground in a small Wiley mill and analyzed for protein, fat, ash, moisture and other substances. The composition of the amino acid indicated that the protein was of a quality similar to meat or fish meal. In two separate 2 week tests, day old chicks were fed one of two formulations containing fly pupae as a protein and fat source. The results indicate that the fly pupae provided enough protein of sufficient quality to support normal growth of chicks during the first two weeks of life. This study is preliminary and more work is required before a valid comparison can be made with the soybean meal now used. It is conceivable that the house fly could be used to convert waste materials into usable, high quality nutrient supplements and thereby assist in alleviating some of the problems of organic waste disposal. (Goessling-Texas)

0083 - A1, F4

BEEF FEEDLOT OPERATIONS IN ONTARIO,
Department of Energy, Mines and Resources,

Burlington (Ontario). Canada Centre for Inland Waters.
A. R. Townsend, S. A. Black, and J. F. Janse.
Journal of the Water Pollution Control Federation, Vol 42, Part 1, p 195-208, February 1970. 3 fig, 10 tab, 10 ref.

Descriptors: *Livestock, *Farm mangement, *Farm lagoons, *Runoff, Seepage, Waste storage, Waste disposal, *Farm wastes.
Identifiers: *Cattle feedlots, *Animal housing, *Manure storage.

The beef feedlot industry in Ontario is described with respect to its environmental pollution problem. Approximately 100,000 cattle are on Ontario feedlots with an estimated 300 head or less per feedlot. Four different types of housing and the associated handling of animal wastes as well as types of pollution from the feedlots is discussed. Animal waste storage should be designed to provide six months capacity and lot runoff storage facilities should be sized to hold the winter snow melt and spring rains until proper waste disposal. The report concludes that feedlot waste disposal will continue to be storage and land disposal rather than treatment and effluent discharge. The three main causes of pollution have been feed storage seepage, feedlot runoff, and land disposal runoff. This report recommends aeration systems such as rotors, aspirators, surface mechanical, and diffused air tubing for odor control. (Waid-Texas)

0084 - A5, B2, C3

FATTY ACID CONTENT AS A MEASURE OF THE ODOUR POTENTIAL OF STORED LIQUID POULTRY MANURE,
Guelph Univ. (Ontario). Dept. of Microbiology.
R. G. Bell.
Poultry Science, Vol 49, No 4, p 1126-1129, July 1970. 4 fig, 7 ref. Ontario Dept of Food and Agr No 695-04 Research Council of Canada No A5730.

Descriptors: *Poultry, *Legislation, *Odor, Farm wastes, Liquid wastes, Gas chromatography.
Identifiers: Fatty acid content, Odor potential.

An attempt was made to find a correlation between odour and the concentration of volatile fatty acids in stored liquid poultry manure. Using both gas chromatographic and column partition chromatographic analysis procedures a relationship between the odour and the fatty acid content of stored liquid poultry manure was observed. A total fatty acid content of 0.1% is suggested as a maximum level to be deemed acceptable for new installations and 0.2% as a minimum level for the initiation of prosecution which may be contemplated for existing facilities. (Christenbury-Iowa State)

0085 - A6, B2

DANGEROUS GASES IN AGRICULTURE.
Ministry of Agriculture, Fisheries and Food, London (England).

Agriculture, Vol 77, No 9, p 431-432, September 1970.

Descriptors: *Gases, Farm wastes, Storage pits, Slurries, Accidents, Waste treatment.
Identifiers: Bacterial decomposition.

Gases from slurry pits can be dangerous to animals and concentrations fatal to man can occur. During storage and bacterial decomposition of the slurry causes a breakdown in organic matter and the release of gases. Recommendations are given that should help prevent accidents. (Christenbury-Iowa State)

0086 - C1, E3

THE APPARENT DIGESTIBILITY OF ENERGY AND PROTEIN IN TOPLAN DRIED POULTRY MANURE,
The University Department of Agriculture, Reading & Thornber Bros. Ltd., Mytholmroyd, Halifax.
B. Lowman, and D. W. Knight.
Animal Production, Vol. 11, No. 2, 1969, p. 276.

Descriptors: *Diets, *farm wastes, *poultry, organic matter, nitrogen, copper, energy, barley, sheep value.
Identifiers: *Digestibility trial, *dried poultry manure, dry matter, crude protein, starch equivalent, feed stuff.

A digestibility trial was carried out to study the apparent digestibility of five components of dried poultry manure, these being dry matter, organic matter, energy, nitrogen, and copper. Five diets were made consisting of various proportions of dried poultry manure and barley, including pure dried poultry manure and pure barley. These diets were each given to 4 castrated male sheep (20 in all), in a randomised block design for a ten-day experimental period. The apparent digestibilities of Toplan dried poultry manure were determined by actual measurement from the pure dried poultry manure diet, and by extrapolation from the other diets. The value of Toplan dried poultry manure was examined in terms of digestible crude protein, metabolizable energy and starch equivalent, and the value of the Toplan dried poultry manure as a feeding stuff for various classes of form livestock was examined in relation to the Agricultural Research Council's recommendations. (White-Iowa State)

0087 - D4

AEROBIC DIGESTION OF CATTLE WASTE,
Illinois Univ., Urbana. Dept. of Agricultural Engineering.
D. D. Jones, B. A. Jones, Jr., and D. L. Day.
Transactions of the American Society of Agricultural Engineers, Vol 11, 1968, p 757-761. 18 fig, 2 tab, 4 ref.

Descriptors: *Farm wastes, *Cattle, *Biochemical oxygen demand, Chemical oxygen demand, Aerobic treatment, Sludge, Aeration, Digestion, Regression analysis, Waste treatment.
Identifiers: *Loading rates, *Aerobic digestion, Dairy cattle, Beef cattle, Volatile solids, Fixed solids, Digesters.

The effectiveness was studied of the aerobic digestion process in the treatment of dairy and beef cattle wastes. Waste from livestock being fed a high-concentrate ration was added in varying loading rates to laboratory aerobic digesters. This experiment indicates that, in the future, less emphasis should be placed on COD, VS, and FS and more on the measurement of BOD, which is a better indication of microorganism activity. BOD reductions of 70,60, and 76 percent and total VS reductions of 20,15, and 0 percent, respectively were obtained for loading rates of 125, 150, and 200 ml. from dairy cattle. Similar results were obtained using beef cattle waste. Under conditions similar to those prevailing in this study, significant reductions in biodegradable organic concentrations can be obtained. (White-Iowa State)

0088 - F1

POULTRY MANURE DISPOSAL - IS THERE A PROBLEM,
C. T. Riley.
Agriculture, Vol 73, 1966, p 110-112.

Descriptors: *Poultry, Costs, Nutrients, Farm wastes, Fertilizers, Value, Waste disposal.
Identifiers: Muck, Handling, Removal.

The cost is examined associated with removal of poultry manure from the house to the disposal point. It is costing the poultry farmer a shilling per bird per year to remove the muck. The fertilizer value of poultry manure should not be overlooked. Farmers dispose enough manure that would be worth 160 units of nitrogen, 160 units of phosphorus and 70 units of potash if applied to a crop. (Christenbury-Iowa State)

0089 - C1, E1

TREATMENT, USE, AND DISPOSAL OF WASTES FROM MODERN AGRICULTURE,
Water Pollution Research Lab., Stevenage (England).
A. B. Wheatland, and B. J. Borne.
Water Pollution Control, Vol 69, No 2, p 195-208, February 1970. 12 tab, 21 ref.

Descriptors: *Farm wastes, *Animal wastes, *Wastes disposal, *Waste treatment, *Waste water disposal, *Waste water treatment, *Biological treatment, *Sludge disposal, *Sludge treatment, Odor, Aerobic treatment, Incineration, Filtration, Hogs, Cattle, Poultry.
Identifiers: *Manures, *Vegetable washings.

With the trend toward larger concentrations of more animals on smaller areas of land nearer population centers, and the trend of the food industry to require washing and packing of vegetables on the farm, the farmer is faced with new problems in waste and waste water treatment and disposal. Values for quantity of excreta, solids, BOD, COD, PV, organic carbon, and total nitrogen are given for cattle, hogs, sheep, poultry, and man. Recent experimental work on animal waste treatment and disposal is discussed. The problem investigated was odor control during storage and spreading of piggery slurry by means of aeration. Problems which occurred included foaming and bulking of the slurry. The treated supernatant was to be recycled for use in washing the animal pens. Possible future methods of treating animal wastes include incineration, wet oxidation, and disposal at sea. Several analyses of vegetable washing waste waters are presented, giving volumes, pH, solids, BOD, COD, PV. Due to the variable nature of the processes involved in vegetable preparation, the actual degree of contamination of the waste water cannot be predicted accurately. Treatment includes minimizing the quantity of waste water to be treated, and primary, biological and sludge treatment and disposal. Primary treatment includes screening and sedimentation. Biological treatment can be by lagoons, aerated lagoons, oxidation ditches, extended aeration, conventional activated sludge, contact stabilization, spray irrigation, biological filtration, or high rate filtration. Sludges can be conditioned, dewatered and disposed at sea or on land. (Makela-Texas)

0090 - A3

WILSCHWITZ RUNOFF SAMPLER,
Wisconsin Univ., Madison. Dept. of Agricultural Engineering.
S. A. Witzel, J. T. Wilke, and F. L. Schmitz.
Transactions of the American Society of Agricultural Engineers, Vol 11, No 6, 1968, p 883, 886. 3 fig, 1 ref.

Descriptors: *Runoff, *Nutrients, *Sampling, Farm wastes, Weirs, Nitrogen, Phosphorus, Potassium, Water levels, Pollutant identification.
Identifiers: Prediction equations, Wilschwitz sampler, Water stage recorder.

The sampler was developed for the purpose of automatic collection of water samples from the flood runoff of small watersheds. It was intended to be used for measuring plant nutrient contained in runoff and not for determining suspended sediment loads. The installation of the Wilschwitz sampler in conjunction with a weir and water stage recorder provides an inexpensive means of obtaining runoff samples at various stages. The unique feature of the sampler is that it operates without auxiliary power. Details of the sampler's construction and operation are given in the article. Data gathered with this sampler are to be used in developing prediction equations relating the rates and amounts of runoff to the plant nutrients lost. If such correlations can be made, equations may be programmed to estimate amounts of nitrogen, phosphorus, potassium or other elements that may be anticipated in the surface water runoff. (White-Iowa State)

0091 - A5, C3, C5

MOISTURE INCREASES MANURE ODORS,

Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering
D. C. Ludington, and A. T. Sabel
Poultry Digest, September 1970, p 445-446. 1 fig, 2 tab, 1 pic.

Descriptors: *Farm wastes, *Odors, Air pollution, Poultry, Ammonia, Hydrogen sulfide, Waste dilution, Chromtography, Organic acids, Pollutant identification.
Identifiers: Masking agents, Counteractants, Deodorants, Organoleptic test.

Studies of handling livestock wastes have shown that increased dilution facilitates faster settling of manure solids, thus requiring constant agitation for efficient removal of solids. Despite some apparent handling advantages of diluted animal wastes, other considerations such as lack of odor control, quantity of material to be handled, availability of water for dilution, and certain pollution may combine to preclude handling as liquid waste. Odor strengths of animal manures have been measured using liquid dilution and vapor dilution. Agitation of liquid manure causes odors to be released and their strength to increase rapidly. A combination of gas chromotographic and organoleptic techniques have been used to determine the chemical compounds responsible for the offensive odor of accumulated liquid poultry manure. Organoleptic tests indicate that the organic acids, mercaptans and sulfides are especially important malodorous components, in addition to the odorous gases ammonia and hydrogen sulfide. An organoleptic test was developed for evaluating over 40 commercial odor control products to use with liquid waste. Masking agents and counteractants were found to be the most effective. The better procedure for controlling air pollution is to prevent the formation of odors rather than attempt to control. A manure-handling system that incorporates moisture removal apparently has some merit. (White-Iowa State)

0092 - B1

SEEK DATA IN FEEDLOT RESEARCH.

South Dakota State Univ., Brookings

South Dakota Farm and Home Research, Vol XXI, No 2, Spring 1970, p 22-27. 2 tab, 8 fig.

Descriptors: *Farm wastes, *South Dakota, *Design criteria, Cattle fertilizers, Biochemical oxygen demand, Water pollution.
Identifiers: *Feedlots, *Farm terraces, Population equivalents, Constituents.

This is a preliminary report of research aimed at coming up with information that can be used by livestock producers, governmental agencies and persons concerned with commercial feedlot design and construction. Some advantageous conditions for feedlot expansion in South Dakota are discussed. Pollution constituents in animal waste and runoff quantities are considered in making some general recommendations as to the design or layout at a feedlot. Six sketches are utilized in presenting some do's and don't's in feedlot design. (Christenbury-Iowa State)

0093 - A2, B2, C2

HYDROLOGIC ASPECTS OF FEEDLOT WASTE CONTROL,

Iowa State Water Resources Research Inst., Ames.
Richard R. Dague, Wayne L. Paulson, and Kenneth J. Kline.
Iowa State Water Resources Research Institute Report No. 69-2, Iowa University, 1969. 37 p, 13 fig, 10 tab, 7 ref. OWRR Project A-022-IA.

Descriptors: *Farm wastes, *Confinement pens, *Waste treatment, *Waste disposal, Lagoons, Water pollution control, Water pollution sources.
Identifiers: Feedlot wastes, Waste management.

The hydrologic factors that require consideration when designing systems for the control of cattle feedlot runoff are considered. A discussion of several methods of controlling feedlot wastes is presented. Significant conclusions: (1) A significant reduction in water pollution from cattle feedlot run off can be accomplished by employing relatively simple and inexpensive runoff control facilities. The size of such facilities can be determined using established techniques for hydrologic and water quality analyses; (2) Using procedures similar to those described herein, it would be possible for control agencies to establish the minimum size of runoff control facilities for each region or major stream basin for each of several possible ultimate runoff disposal practices; and (3) Caution should be exercised in applying the term 'population equivalent' to cattle feedlot wastes. Any use of the term must consider the fact that the fraction of the total waste that enters water is extremely variable from one location to another and is heavily dependent upon the quantity and time variation in precipitation, the cattle density on the feedlot, and the topographic characteristics of the lot.

0094 - D4

THE INFLUENCE OF AERATION ON THE COMPOSTING OF POULTRY MANURE-GROUND CORNCOB MIXTURES,

Guelph Univ. (Ontario). Dept. of Microbiology.
R. G. Bell.
Journal of Agricultural Engineering Research, Vol 15, No 1, p 11-16, 1970. 5 fig, 2 tab, 8 ref.

Descriptors: *Farm wastes, *Aeration, *Poultry, Laboratory tests, Odor, Salmonella sp., Temperature, Depth, Microorganisms, Waste water treatment.
Identifiers: *Composting, Corncob mixtures, Canada, Microbial activity.

The influence of the rate of aeration on 1.5m colums of composting mixtures of 2 parts poultry manure and 1 part ground corncob was investigated. The results indicate that the optimum aeration rate for the production of a stable sanitary compost was 4 liters of air/m2/min for every 10 cm of composting material up to a maximum depth of about 2.4 m. A detailed discussion of the materials, methods and results is presented. (Christenbury-Iowa State)

0095 - D4

BIO-OXIDATION OF SWINE WASTE BY THE ACTIVATED-SLUDGE PROCESS,

Iowa State Univ., Ames. Dept. of Agricultural Engineering.
Ronald E. Hermanson, Thamon E. Hazen, and Howard P. Johnson.
Transactions of the American Society of Agricultural Engineers, Vol 12, No 3, 1969, p 342-348. 5 fig, 1 tab, 19 ref.

Descriptors: *Farm wastes, *Hogs, *Activated sludge, *Model studies, Anaerobic conditions, Farm lagoon, Regression analysis, Least squares method, Biochemical oxygen demand, Aeration, Settling basins, Nitrogen, Temperature, Effluent, Dissolved oxygen, Hydrogen ion concentration, Waste water treatment.
Identifiers: *Extended aeration, BOD-reduction efficiency, Mixed liquor, Aeration tank, Suspended solids.

The purpose of this research was to investigate the extended-aeration, activated-sludge process of swine waste treatment. Two objectives were: (1) to develop a mathematical model for the BOD-reduction efficiency of the process, and (2) to verify the model and evaluate its coefficients by conducting experiments with a laboratory-scale plant. The components of the activated-sludge treatment plant were as follows: (1) an aeration tank; (2) an aeration system; (3) a sedimentation tank; and (4) a mechanism for returning settled activated sludge to the aeration tank. The experimental model was comprised of an aeration tank and a sedimentation tank made of Plexiglas, with two galvanized sheet metal sedimentation tanks as alternates. Three capacities were required in the sedimentation section to provide suitable detention times over the range of flow rates used. The following conclusions resulted from this research. (1) Effluent from an anaerobic lagoon is sufficiently constant to be a practical influent substrate for model studies. (2) Excessive solids loss because of denitrification can be avoided by proper design of the sedimentation tank, provided the flow rate does not vary widely. (3) The mathematical model satisfactorily predicted the BOD-reduction efficiency of an extended-aeration, activated-sludge plant, as evidenced by the reasonably high multiple r2 (0.92) and the low standard error (2.6 percent) of the experimental regression equation. (4) The aeration tank of an extended-aeration activated-sludge plant for the treatment of the effluent from an anaerobic swine lagoon designed according to the equation developed. (White-Iowa State)

0096 - A5, A6, C3

IDENTIFICATION OF GASES IN A CONFINEMENT SWINE BUILDING ATMOSPHERE,

Iowa State Univ., Ames. Dept. of Agricultural Engineering.
J. A. Merkel, T. E. Hazen, and J. R. Miner.
Transactions of the American Society of Agricultural Engineers, Vol 12, No 3, 1969, p 310-313 and 315. 5 fig, 1 tab, 11 ref.

Descriptors: *Farm wastes, *Hogs, *Odor, *Gases, Confinement pens, Sulfur compounds, Ammonia, Amino acids, Porteins, Carbohydrates, Lipids, Organic acids, Solubility, Hydrogen ion concentration, Chromatography, Alcohols, Sulfides, Salting, Absorption, Condensation, Pollutant identification.
Identifiers: Acid-forming, Methane-producing, Manure storage pit, Amides, Amines, Carbonyls, Esters, Mercaptans.

In addition to the already known fixed gases, CO_2, CO, H_2S, NH_3, CH_4, etc., the environment within a confinement swine unit was found to contain a complex mixture of volatile organic intermediates. These intermediates are important in the characteristic odor resulting from the storage of manure and are suspected as being important in animal and building performance. Consideration of physical as well as organic, biochemical phenomena indicated that the important intermediate products of anaerobic manure decomposition include organic acids, amines, amides, alcohols, carbonyls and sulfides. Qualitative chemical analysis confirmed the presence of these homologous groups, except for organic acids that were decomposed upon formation by the high pH maintained within the manure storage pit. To identify individual compounds within the swine environment, concentration of the volatile gases was required. Selective absorption, liquid salting and selective condensation were each used in an effort to separate and concentrate the homologous series. Once separated, the series were subj[illegible] to chromatographic analysis for separation and identification. Physiological odor investigations have been conducted to indicate the important compounds in the specific odors in swine buildings. Work to date indicates that the major odor constituents are from the amine and sulfide groups. Further work is under way to separate these compounds. (White-Iowa State)

0097 - B2, D4

POULTRY MANURE LAGOON DESIGN,

California Univ., Davis. Agricultural Extension Service.
Robert A. Parsons, Fred Price, and W. C. Fairbank.
Poultry Digest, Vol 29, No 344, p 485-488, October 1970. 6 fig.

Descriptors: *Farm wastes, *Poultry, *Lagoons, *Design criteria, *Odor, Cleaning, Recirculated water, Costs, Anaerobic conditions, Anaerobic bacteris, Aerobic conditions, Aerobic bacteria, Aeration, Waste water treatment.
Identifiers: *Flushing gutter, Macerated chicken carcasses, Floating debris, V-trough, Washout system, Overload, Malfunctions, Gutter design, Thiopedea roses.

This paper deals with lagoon design criteria for poultry manure. A lagoon is a satisfactory means of poultry manure disposal. The lagoon should be used only in rural areas that are tolerant of varied but dilute odors of farm production. Overloading is about the only cause of lagoon malfunction. Size requirements, construction, flushing system, and lagoon operation are discussed. (Christenbury-Iowa State)

0098 - C1, D4

BEEF CONFINEMENT SYSTEMS - OXIDATION DITCH,

Minnesota Univ., Minneapolis. Dept. of Agricultural Engineering.
J. A. Moore, R. E. Larson, R. O. Hegg, and E. A. Allred.
Paper No 7331 in the Scientific Journal Series, Minnesota Agricultural Experiment Station; and Paper No 70-418, American Society of Agricultural Engineers, July 1970.

Descriptors: *Farm wastes, *Cattle, Chemical oxygen demand, Biochemical oxygen demand, Ventilation, Rotors, Foaming, Temperature, Hydrogen-ion concentration, Dissolved oxygen, Nitrogen, Ammonia, Waste water treatment.
Identifiers: *Oxidation ditch, Beef cattle, Loading rates, Solids.

The oxidation ditch has been used in Minnesota for two years for treatment of beef cattle wastes. It has been operated as a batch system with various loading rates and environmental conditions. Results are evaluated on the basis of BOD, COS, TS, TVS, pH, nitrogen, temperature of the waste, and odor and foam control. Waste management systems are employed by beef operators to meet certain objectives. These objectives may vary widely depending on such factors as management, labor requirements, climate, size and nature of operation, land availability, soil type and geologic formation and population density. No one waste system is best for all operations. Each system has advantages and disadvantages to offer for any given operation. The oxidation ditch offers the following characteristics: very low odor level, waste storage eliminates runoff, volume reduction of solids, reduction of pollution strength, concentration of some elements, necessity of continuous operation, one of more expensive treatment systems, and a buildup of solids on the bottom. Based on the results obtained from 2 1/2 years of research the authors feel that the oxidation ditch does have a place in treating beef cattle waste from confinement operations. (White-Iowa State)

0099 - D4

REMOVAL OF NITRATE BY AN ALGAL SYSTEM,

California State Dept. of Water Resources, Fresno. San Joaquin District.
Randall L. Brown. Environmental Protection Agency - Water Quality Office, Water Pollution Control Research Series, April, 1971, 132 p, 58 fig, 27 tab, 59 ref. EPA Program 13030 ELY.

Descriptors: Agricultural wastes, Water pollution control, *Biological treatment, *Nitrates, Treatment facilities, Algae, *Waste water treatment, *Algal control, *Aquatic weed control, California.
Identifiers: *Algae stripping, Scenedesmus, Algal growth, Algal harvesting, *San Joaquin Valley (Calif).

An algal system consisting of algae growth, harvesting and disposal was evaluated as a possible means of removing nitrate-nitrogen from subsurface agricultural drainage in the San Joaquin Valley of California. The study of this assimilatory nitrogen removal process was initiated to determine optimum conditions for growth of the algal biomass, seasonal variations in assimilation rates, and methods of harvesting and disposal of the algal product. A secondary objective of the study was to obtain preliminary cost estimates and process design. The growth studies showed that about 75 to 90 percent of the 20 mg/l influent nitrogen was assimilated by shallow (12-inch culture depth) algal cultures receiving 2 to 3 mg/l additional iron and phosphorus and a mixture of 5 percent CO2. Theoretical hydraulic detention times required for these assimilation rates varied from 5 to 16 days, depending on the time of the year. The total nitrogen removal by the algal system, assuming 95 percent removal of the algal cells, ranged from 70 to 85 percent of the influent nitrogen. The most economical and effective algal harvesting system tested was flocculation and sedimentation followed by filtration of the sediment. The algal cake from the vacuum filter, containing about 20 percent solids, was then air- or flash-dried to about 90 percent solids. The market value for this product as a protein supplement was estimated to be about $80 to $100 per ton. Miner-Iowa State)

0100 - A3, A4, B1, C1, E2

ANIMAL WASTE UTILIZATION FOR POLLUTION ABATEMENT,

Nebraska Univ., Lincoln. Dept. of Agricultural Engineering.
O. E. Cross, A. P. Mazurak, and L. Chesnin.
Preprint, presented at American Society of Agricultural Engineers 1971 Winter Meeting, Chicago, Illinois, December 7-10, 1971, Paper no 71-906. 23 p, 8 fig, 9 ref. OWRR B-003-NEB (3).

Descriptors: *Farm wastes, *Cattle, Rates of application, *Furrow irrigation, Surface runoff, Groundwater movement, Nitrogen, Phosphorus, Potassium, Electrical conductivity, Crop response, Nutrients, Percolation, Sudangrass, *Path of pollutants, Pollution abatement.
Identifiers: *Feedlot wastes, Runoff losses, Surface runoff pollution.

Beef feedlot manure was applied to plots at levels of 0, 40, 120 and 260 tons dry matter per acre. The manure was disk plowed into the soil at 4, 8, and 12 inch depths. A sorghum-sudan forage was seeded at three plant populations, a 'low,' 'medium,' and 'high' density and was furrow irrigated according to standard irrigation techniques. Data was documented as to: pollutional potential of surface runoff water, pollutional contribution to underground water supply, physical and chemical changes in the soil, irrigation techniques, and crop response. The conclusions are the result of one year's test. Nitrogen and sodium displacement did not pollute the surface runoff water. The transport of potassium restricted the runoff to irrigation uses only. However, the underground water was not affected by the plots and retained its potable quality. Additional information is required to establish irrigation techniques; however, to date conclusions are: (1) the initial intake rate of water into the soil increases as higher manure loadings are applied, (2) the basic intake rate is higher on areas plowed 8 inches deep as compared to areas plowed 4 or 12 inches deep, and (3) the basic intake rate increases with time elapse after application. The application of manure increased the crop yield with the exception of the 260 ton application. (Bundy-Iowa State)

0101 - B3, E3

MANURE MANAGEMENT - COSTS AND PRODUCT FORMS,

Los Angeles County Agricultural Extension Service, Calif.
J. Van Dam, and C. A. Perry.
California Agriculture, Vol 22, No 12, December 1968, p 12-13. 2 tab, 2 fig.

Descriptors: *Farm wastes, *Cattle, *Marketing, *Costs, Volume, Profit, Management.
Identifiers: *Feedlots, *Processing plant, Stockpiles, Packaging, Bulk, Pulverizer, Product forms, Delivery, Removal.

A study to determine the actual cost of removal and disposal of manure from a beef feedlot in Los Angeles County was completed by the Agricultural Extension Service. Manure was prepared for marketing in three basic forms and sold under four pricing conditions. Manure processing, packaging and marketing began with the mounding of the manure in the corrals followed by its removal to a compost stockpile. Manure was allowed to cure in a compost pile at least six months before processing. The manure could then be marketed unprocessed as composted manure; marketed processed as composted bulk; and marketed processed as composted packaged manure. The combined fixed and variable costs per cubic yard amounted to 10.5 cents for the unprocessed product, 65 cents for the processed bulk and $1.88 for the packaged processed form. The weighted average price received per cubic yard was $3.80 for the packaged, $2.40 for the processed bulk, and $1.40 for the unprocessed bulk manure. A livestock feedlot operator can probably make a profit from the sale of manure. (White-Iowa State)

0102 - A1, B1, F2

POLLUTION CONTROL - FEEDLOT OPERATIONS,

Iowa State Univ., Ames.
J. R. Miner, E. R. Baumann, T. L. Willrich, and T. E. Hazen.
Journal of the Water Pollution Control Federation, Vol 42, No 3, p 391-398, March 1970. 1 tab, 6 ref.

Descriptors: *Livestock, *Pollution abatement, Waste disposal, Reservoirs, Waste treatment, Cattle, Sewage treatment, Farm wastes, Iowa, Hogs, Poultry.
Identifiers: *Feedlot, Population equivalent.

The increase in labor cost and a shortage of personnel has caused an increase in feedlot population. The result has been a concentration of livestock waste level. Techniques of feedlot waste systems design are reported, and methods of collecting and disposing of the waste are discussed. These cattle, swine, and poultry feedlot operations are similar. Types of flooring and methods of cleaning are discussed. Treatment and disposal of the waste are commented on, including tank storage and hauling, anaerobic lagoons, aerobic lagoons, surface irrigation systems and oxidation ditches. The limiting factors of various treatments in relation to feedlot waste are reported. Zoning regulations are suggested as a partial solution to nuisance complaints which are generated by concentration of livestock in feedlots. (Hancuff-Texas)

0103 - A6, C2

NITROGEN ENRICHMENT OF SURFACE WATER BY ABSORPTION OF AMMONIA VOLATILIZED FROM CATTLE FEEDLOTS,

Agricultural Research Service, Fort Collins, Colo. Soil and Water Conservation Research Div.
G. L. Hutchinson, and F. G. Viets, Jr.
Science, Vol 166, No 3904, p 514-515, Oct 1969. 1 fig, 1 tab, 6 ref.

Descriptors: *Nitrogen, *Surface water, *Absorption, *Ammonia, Eutrophication, Water pollution sources, Nitrogen compounds, Nutrient cycling, Fertilization, Colorado, Precipitation (Atmospheric), Lakes, Streams.
Identifiers: *Nitrogen pollution, *Cattle feedlots, Seeley Lake (Colo), Nitrogen (Total), Nitrogen (Inorganic), Nitrogen enrichment.

A method is described for estimating nitrogen enrichment of surface waters resulting from volatilization of ammonia from cattle feedlots and its subsequent absorption into lakes and streams. Rates of ammonia absorption into dilute sulfuric acid (0.01 normal) measured near feedlots were as much as 20-fold greater than controls; estimated annual absorption (in kilograms/hectare) of 73 at site about 0.4 kilometers west of 90,000-unit feedlot can be compared with 3.9 at control site with no feedlots or irrigated fields within 3 milometers and no large feedlots or cities within 15 kilometers. Ammonia absorbed by surfaces of natural waters are apparently about half that estimated by method described. That a large feedlot can enhance nitrogen enrichment of aqueous surfaces at some distances is suggested by evidence that a fivefold increase in distance from a feedlot decreased mean ammonia absorption rate by approximately one-half. Absorption rates from smaller lots were approximately 25% of large one, but above fourfold greater than control. Authors believe that wide fluctuations in ammonia absorption rates reflect the moistness of feedlot surfaces, rapid drying enhancing volatilization and absorption. Authors conclude that such feedlots are substantial sources of nitrogen pollution for nearby surface waters. (Eichhorn-Wisconsin)

0104 - A2

MODELING FEEDLOT RUNOFF POLLUTION,

Kansas State Univ., Manhattan. Dept. of Chemical Engineering; and Kansas State Univ., Manhattan. Dept. of Agricultural Engineering.
J. R. Miner, R. I. Lipper, and L. E. Erickson.
Transactions of the ASAE, Vol 10, No 4, p 497-501, 1967. 5 tab, 8 fig, 7 ref.

Descriptors: *Farm wastes, *Runoff, *Chemical oxygen demand, *Model-studies, Cattle, Water pollution, Hydraulic models, Discharge, Depression storage, Hydrographs, Hydrology, Rainfall intensity, Simulated rainfall.
Identifiers: *Feedlot, *Stirred tank with injection model, Concentration, Nonsurfaced lot, Concrete-surfaced lot, Soil cover complex number.

Most emphasis of this paper was on quality aspects of feedlot runoff; however a brief discussion of possible hydraulic models is given. Three concentration models are described and their ability to predict feedlot runoff water quality is shown. The three are, the stirred tank concentration model, stirred tank with injection concentration model, and the series-stirred tanks with injection concentration model. The three concentration models provided progressively better data representation as their complexity increased. Two experimental cattle feedlots especially designed for runoff investigation were used in the study. Associated with the feedlots were rainfall simulation and measuring equipment, and runoff measuring and proportional sampling facilities. One lot was concrete surfaced, the other had concrete only around feed bunks. Tempered by good judgement, feedlot models can be used to help predict organic concentration of runoff from a feedlot. When an improved hydraulic model is developed, it can be combined with either of the single, stirred tanks to provide a single feedlot model to predict overall water-pollution potential. (White-Iowa State)

0105 - A5, C2, C3

AMMONIA AND AMINES: COMPONENTS OF SWINE-BUILDING ODOR,

Iowa State Univ., Ames. Dept. of Agricultural Engineering.
J. R. Miner, and T. E. Hazen.
Transactions of the ASAE, Vol 12, No 6, 1969. 3 p.

Descriptors: *Farm wastes, *Hogs, *Odors, *Ammonia, Atmosphere, Anerobic digestion, Proteins, Amino acids, Isolation, Chemical properties, Density, Physical properties, Absorption, Chromatography.
Identifiers: *Amines, *Odor thresholds, Concentration, Boiling points, Dissociation constants, Detection, Animal chambers.

This paper represents another step in defining the atmosphere within the swine confinement building. Ammonia and the closely related amines are known to be produced during the decomposition of both animal and vegetable proteins. Research work involving gases over decomposing manure indicate amines, ammonia and sulfur containing compounds are probably important constituents of the swine odor. The paper outlines the formation of ammonia and amines, and gives threshold odor levels for them in air. Physical and chemical properties of the different amines are given as well as methods of isolation and detection. Experimental data was taken from two animal chambers which provided substantial control over environmental conditions. The measured concentrations of ammonia were less than the threshold odor levels, indicating one of two explanations must be true: (a) Ammonia is not an important component of the hog house odor or (b) the odor producers are additive in effect and ammonia can be perceived at concentrations below its threshold when combined with other odorous compounds. Chromatographic analysis was used for detection of the different amines. (White-Iowa State)

0106 - D4

OXIDATION DITCHES FOR WASTE DISPOSAL,

Illinois Univ., Urbana. Dept. of Agricultural Engineering.
Donald L. Day.
International Journal Of Farm Building Resources, No 2, December 3, 1968, p 2-7. 9 fig, 9 ref.

Descriptors: *Farm wastes, *Hogs, *Biochemical oxygen demand, *Rotors, Foaming, Sludge, Effluent, Odors, Carbon dioxide, Oxygen, Depth, Dissolved oxygen, Electric power, Electric power costs, Volume, Velocity.
Identifiers: *Oxidation ditch, Population equivalent, Suspended solids, Slatted floors, Extended aeration.

The oxidation ditch is an efficient low-cost process for the treatment of municipal waste. It has several aspects that seem desirable for use in confinement livestock waste-treatment systems. The aerobic method is an odorless process with final products of water, carbon dioxide, and stable minerals. The oxidation ditch can be integrated into a self-cleaning slatted floor system. However, control of foaming is an immediate problem that must be solved before the process can be unconditionally recommended, even just for control of the odors in the gutter and when spreading on land. Operational criteria must be developed if the method is to serve for complete treatment of livestock manure, with an effluent that can be accepted by public health and water board standards. Adaptations of the oxidation ditch for the treatment of livestock manure are surely forthcoming, in view of the intense research that is in progress in the United States and abroad. However, until the current problems are resolved, the disposal of livestock manure in a manner that does not have an odor nuisance and a water pollution hazard remains a complicated problem. (White-Iowa State)

0107 - B3, D2

DRYING POULTRY MANURE INSIDE THE POULTRY HOUSE,

Pennsylvania State Univ., University Park. Dept. of Poultry Science.
Glenn O. Bressler.
Agricultural Engineering, Vol 51, No 3, p 136, March 1970.

Descriptors: *Farm wastes, *Poultry, *Drying, Ventilation, Waste storage.
Identifiers: *Poultry manure.

In this drying system droppings are removed at a very low moisture level, cutting weight of material to be handled by two-thirds. Eight 3000-cfm circulating fans are mounted about 22 ft. apart directly below 2 lines of water troughs that run the full length of the house. Fans are about 10 in. above the manure; air velocities over the droppings are about 250 to 750 fpm. A spike-tooth harrow is pulled daily through the accumulating droppings to stir them and to draw partially dried droppings into the high-velocity airstream. From the pit the droppings go either to truck or manure spreader or to a hammermill to be finely ground and bagged. The amount of water removed daily to prevent excess humidity and to dry the manure ranged from 6-9 gallons per hour. These results are from a flock of 3246 pullets and cockerels at 22 weeks in a 30-ft. by 100-ft. environment-controlled laying house. (White-Iowa State)

0108 - C4, C5

EFFECTS OF FEED CONSUMPTION ON BIOCHEMICAL OXYGEN DEMAND OF STEER EXCRETA,

Kentucky Univ., Lexington. Dept. of Agricultural Engineering.
K. C. Mills, B. F. Parker, and I. J. Ross.
Transactions of the ASAE, Vol 12, No 1, 1969, p 133. 2 ref.

Descriptors: *Farm wastes, *Cattle, *Biochemical oxygen demand, Feeds, Silage, Grains, Pastures, Oxidation, Aerobic treatment, Sampling, Testing.
Identifiers: *Feed composition, Steers, Alsterberg modification, Winkler method.

The objective of the study on which the paper is based was to determine some of the effects of animal-feed composition of the rate of aerobic breakdown of animal waste. If differences in rate of aerobic breakdown occur because of feed composition, these differences should be proven by conducting biochemical oxygen demand tests on the wastes from animals on different feed. Thus excreta for BOD tests were obtained from three groups of steers being fed on all grain, grain and silage, and on pasture. The data for the pasture had much greater variability from week to week. Data on all tests are available in the original thesis and ASAE paper No. 67-930. It was concluded that the composition of animal feed will change the biochemical oxygen demand of animal excreta. This fact should be considered when designing aerobic systems for treating animal wastes. (White-Iowa State)

0109 - B3, C5

SOME CAUSES OF WET POULTRY MANURE,

Georgia Univ., Athens.
O. W. Charles.
Georgia Poultry Tips, August 1, 1970. Poultry Digest, September 1970, p 431.

Descriptors: *Farm wastes, *Poultry, *Moisture

content, Water consumption, Strain, Salts, Carbohydrates, Lipids, Proteins, Water pollution sources.
Identifiers: *Ration, Water intake, Uric acid.

Excessive moisture in poultry manure may be due to a number of factors, among which is a tendency for certain strains of birds to produce higher percentage of moisture in the fecal material than other strains. Water represents by far the largest portion of fresh poultry manure. Reports of several researchers are cited as to moisture content and differences in strain. It was found that moisture content of the droppings of low water consuming strains was only 50%, while moisture content of droppings in the high water consuming strain reached 71%. Excessive amounts of salt and a concept of balance in the ration are also discussed as causes of excessive moisture. (White-Iowa State)

0110 - C4

ISOLATION OF SALMONELLAE FROM RENDERED BY-PRODUCTS AND POULTRY LITTER CULTURED IN ENRICHMENT MEDIA INCUBATED AT ELEVATED TEMPERATURES,
Massachusetts Univ., Amherst. Dept. of Veterinary and Animal Sciences.
C. F. Smyser, G. H. Snoeyenbos, and Barbara McKie.
Avian Diseases, Vol 14, No 2, 1970, p 248-254. 6 tab, 13 ref. US Public Health Service Grant UI 00159-05.

Descriptors: *Poultry, *Salmonella, *Incubation, Farm wastes, Isolation, Temperature, Hydrogen ion concentration, Indicators.
Identifiers: *Enrichment media, Poultry litter, Rendered bynproducts, Plating medium

Three enrichment media incubated at 42 plus or minus 1C were compared for isolating Salmonellae from rendered animal and marine by-products, and two of the media were compared for poultry litter. Salmonellae were recovered from 317 of the 755 rendered samples and from 203 of the 235 litter samples examined. Selenite brilliant-green sulfapyridine (SBG sulfa), dulcitol selenite sulfapyridine (DSES), and tetrathionate brilliant-green (TBG) were equally effective. Each enrichment incubated at the elevated temperature was significantly more effective than TBG incubated at 37C for isolating salmonellae from fish meal. Essentially no difference was noted between brilliant-green (BG) agar and brilliant-green sulfadiazine (BGS) agar as a plating medium. The pH of the enrichment media at the termination of incubation could not be used as an indicator of the presence or absence of salmonellae. (White-Iowa State)

0111 - A5, D2

UNDER-CAGE MANURE DRYING SYSTEM SOLVES ODOR PROBLEMS,
Cloisterdale Farms, Ephrata, Pa.
Glenn H. Herr.
Farm Service Bulletin, July-August, 1970. Poultry Digest, Vol 29, No 344, p 476-479, October 1970. 4 fig.

Descriptors: *Farm wastes, *Poultry, *Odors, *Aeration, *Disposal, Economics, Aerobic conditions, Forced drying, Liquid wastes, Drying, Lagoons, Anaerobic bacteria, Costs, Waste water treatment.
Identifiers: *Stirring, Odor-causing bacteria, Semi-dry manure.

This paper deals with the problems and their solutions encountered by a commercial poultry farm with odors and waste management. The various systems that were tried unsuccessfully are discussed. Their solution was one developed by Dr. Glenn Bressler and co-workers at Pennsylvania State University for drying the manure. The system employs a stirring device and forced air to keep the manure aerobic. The manure is dried to one-third its original weight which has eliminated many of their disposal problems. The cost of the system is discussed. (Christenbury-Iowa State)

0112 - F4

CURRENT TRENDS IN FARM WASTE DISPOSAL,
Ministry of Agriculture, Fisheries and Food, London (England).
C. T. Riley.
Water Pollution Control, Vol 69, No 2, p 174-179, February 1970. 3 tab.

Descriptors: *Animal wastes, *Farm wastes, Cattle, Hogs, Poultry, Odor.
Identifiers: *Manure, *Population equivalents.

Much emphasis has been placed on farm waste disposal in the past five years. Reasons for this include the increased size of livestock units, nearness of units to consumers, recent legislation on river pollution control and water resources, and reaction from the public and farm workers to flies and odor associated with animal wastes. In 1967, the total volume of excreta produced by livestock in the United Kingdom was 121 million tons, with a population equivalent of 136 million. Much of this excreta is spread on the land by ranging animals. The remainder must undergo some form of disposal by man. The wastes can be handled in any of four basic methods. (1) as a solid, it is stored and spread on land once or twice a year. (2) as a semi-solid, it is spread daily. (3) as a slurry, it is handled by vacuum tanker, stored, and spread. (4) as a liquid, it is washed by water to a storage tank and spread by spray irrigation. The trend is toward solid or semi-solid handling. Factors affecting disposal method include land availability, land area, volum of excreta, soil type, crops to be grown, and climatic conditions, especially rainfall. More emphasis is now placed on planning of waste disposal before starting farm projects. Odors can be eliminated by aeration of wastes in the tanker before spreading or spraying on the land. (Makela-Texas)

0113 - B1

LOCATING A POULTRY ENTERPRISE,
Illinois Univ., Urbana.
S. F. Ridlen, and Hugh S. Johnson.
Illinois Monthly Poultry Suggestions, July 1970. Poultry Digest, Vol 29, No 344, p 495-496, October 1970.

Descriptors: *Locating, Farm wastes, *Poultry, Eggs, Water pollution control.
Identifiers: *Enterprise, Neighbor problems.

The chief characteristics that should be evaluated in selecting the location of a poultry enterprise are discussed. These include land cost, tax rate, water supply and topography; electricity, labor, feed supply and transportation should be considered; human population, zoning, acceptance of poultry by local people and relationship to market are important. (Christenbury-Iowa State)

0114 - A1, B1, F1, F4

SWINE MANURE -- LIABILITY OR ASSET,
Purdue Univ., Lafayette, Ind.
David H. Bache.
Paper presented at the American Pork Conference, Des Moines, Iowa, March 3, 4, and 5, 1970. 13 p, 10 ref.

Descriptors: *Farm wastes, *Economics, *Costs, Water pollution, Air pollution, Confinement pens, Storage capacity, Fertilizers, Swine, Cattle, Poultry, Lagoons, Odor, Oxidation, Legislation.
Identifiers: *Assets, *Liability, Slatted floors, Land disposal, Innovators penalty, Pollution abatement grants.

Swine manure is a very modest asset on crop farms and it can be a major liability on those production units with no crop land base. A literature and research review gives costs and economic value of different manure treatment systems through the past ten or fifteen years. Conclusions reached include: there is no waste disposal problem with a pasture system, there is no economically feasible alternative to the spreading of solid manures, smaller swine production units will probably find that lagoon disposal is the optimum technique for handling hog wastes, and larger production units will be shifting to the use of slatted-floors, under floor manure forage, and liquid disposal systems. Public concern and legislation is discussed. (White-Iowa State)

0115 - F4

MANAGEMENT OF FARM ANIMAL WASTES.
American Society of Agricultural Engineers, St. Joseph, Mich.
Proceedings National Symposium on Animal Waste Management, May 1966, 161 p. Michigan State University, ASAE Publication No. SP-0366.

Descriptors: *Farm wastes, *Management, *Public health, *Water pollution sources, *Livestock, *Waste disposal, *Slurries, *Lagoons, *Biological treatment, Waste storage, Physical properties, Odor, Distribution systems, Irrigation, Labor, Environmental sanitation, Sludge treatment, Incineration, Feeds.
Identifiers: Feedlot runoff, Production, High density systems, Handling, Slatted floors, Materials, Handling, Liquid manure, Equipment design, Waste management, Oxidation ditches, Composting, Kjeldahl nitrogen, Coprophagy.

The National Symposium on Animal Waste Management had three main objectives: (1) To delineate the problem of managing animal waste, (2) To evaluate our current technology in the management of our farm wastes (technology in the farm waste management was divided into methods of handling, treatment, utilization, and disposal) and (3) To stimulate and give new direction to future research in solid wastes management. Fifty-one papers were presented representing eighty-nine professionals - from industry, campus and government; from manufacturing, research, extension and regulatory agencies; as animal scientists, bacteriologists, economists, engineers, and sanitarians. The last three pages of the publication are devoted to ASAE recommendation (ASAE R292): Uniform Terminology for Rural Waste Management. (Christenbury-Iowa State)

0116 - C2, C3, C4

PHYSICAL, CHEMICAL AND BACTERIOLOGICAL PROPERTIES OF FARM WASTES (BOVINE ANIMALS),
Michigan State Univ., East Lansing.
S. A. Witzel, E. McCoy, L. B. Polkowski, O. J. Attoe, and M. S. Nichols.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No. SP-0366, p 10-14, May 1966. 10 tab, 19 ref. USDI No. 8 RO1 SW 00042-02.

Descriptors: *Farm waste, *Waste disposal, *Cattle, *Biochemical oxygen demand, Chemical oxygen demand, Anaerobic conditions, Aerobic conditions, Hydrogen ion concentration.
Identifiers: *Lagoon flora, *Population equivalents, *Liquid manure, Liquid manure tank, Volitile solids, Plant response.

This report characterizes pollutants derived from farm animal (Bovine) waste. Wastes were collected from dairy bulls, dairy cows, and beef cattle. The wastes were analyzed for volume, suspended solids, percent BOD and COD. Further analysis show the effects of treating manure on yield and recovery of N, P, and K by corn plants. The data indicate that high concentrations of bacteria (dead or alive), volatile solids, BOD and COD are found in waste from bovine animals. The study indicated that reduction by lagoon retention, settling, aerobic or anaerobic digestion does not remove sufficient amounts of volatile solids, BOD and COD to provide safe effluent for disposal in streams. Indications are that liquid manure handling by farmers may be the most feasible approach for waste disposal. (See also W71-01992). (Christenbury-Iowa State)

0117 - C1, F5

DUCK-PROCESSING WASTE,
Robert S. Kerr Water Research Center, Ada, Okla.
Grover L. Morris.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No. SP-0366, Michigan State University, May 1966, p 15-18. 6 tab, 6 ref.

Descriptors: *Farm wastes, *Poultry, *Coliforms, Biochemical oxygen demand, Chemical analysis.
Identifiers: *Evisceration, Long Islands ducks, Waste loads.

Objectives of the study were (a) to measure and evaluate duck processing plant waste loads and (b) to observe plant operations for possible reduction in total water use by redistribution or by reuse of certain waters presently discharged to waste after one use, or by a combination of redistribution and reuse. Study of two duck-processing plants located on Long Island provides data pertaining to water use, waste loads, and general operation. The finished product is a high-quality duck of considerable delicacy. Water use in duck-processing plants seems high when compared with water used in chicken processing. Means of reducing the amount of water used are discussed.
(Christenbury-Iowa State)

0118 - A7, A9, C4

HEALTH ASPECTS AND VECTOR CONTROL ASSOCIATED WITH ANIMAL WASTES,
Public Health Service.
W. M. Decker, and J. H. Steele.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No. SP-0366, Michigan State University, May 1966, p 18-20. 12 ref.

Descriptors: *Farm waste, *Zoonoses, *Salmonella, *Mycobacterium, *Diseases, Water pollution sources, Public health.
Identifiers. *Pathogenic organisms, Brucella, Leptospira.

The diseases contracted by man from animals are discussed. Q fever, Anthrax, Salmonellosis, Tuberculosis, Brucellosis, and Leptospirosis are the major diseases examined. The source of the disease and the means by which man contracts the diseases are presented. Other pathogenic organisms arising from animals are mentioned.
(Christenbury-Iowa State)

0119 - A8

BIOLOGICAL INTERRELATIONSHIPS BETWEEN FECES AND FLIES,
California Univ., Berkeley.
John R. Anderson.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No. SP-0366, Michigan State University, May 1966, p 20-23. 35 ref.

Descriptors: *Farm wastes, *Domestic wastes, Confinement pens, Livestock.
Identifiers: *Filth flies, *Livestock-husbandry operations, *Fly populations, Livestock production methods, High-density confinement.

This report discusses the effects on fly populations as affected by changes in livestock production methods. Field research has indicated that the foremost cause for the prodigious number of flies today is the recent widespread occurence of low-area, high-density concentrations of animals in all phases of livestock-husbandry operations. Although recent changes in livestock husbandry have created serious fly problems, the possibilities for constructively managing manure to avoid or reduce the production of flies under today's low-area, high-density confinement of animals appear much better than with previous technologies.
(Christenbury-Iowa State)

0120 - A2, C2, C3, C4

STORMWATER RUNOFF FROM CATTLE FEEDLOTS,
Kansas State Univ., Manhattan.
J. R. Miner, L. R. Fina, J. W. Funk, R. I. Lipper, and G. H. Larson.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 23-27. 8 tab, 9 fig, 11 ref.

Descriptors: *Water pollution, *Detention reservoirs, *Farm waste, Waste storage, Nitrogen compounds, Organic waste, Rainfall intensity, Coliforms, Streptococcus, Chemical oxygen demand, Bacteria.
Identifiers: Rainfall duration, Feedlot runoff, Bacteriological activity, Kjeldahl nitrogen, Pollution potential.

Runoff characteristics from two experimental cattle feedlots were studied. Runoff was high-strength organic waste containing large quantities of nitrogenous compounds. The nitrogenous matter was being transformed continuously by bacteriological activity. More organic matter and Kjeldahl nitrogen were found in the runoff (a) with low-intensity rainfall, (b) with moist conditions preceding rainfall, and (c) during warm weather. Cattle feedlot runoff was a concentrated source of bacteria that normally are used to characterize water quality. Hydrologic characteristics of feedlot waste contribute to their stream-pollution potential. A detention pond seems feasible to prevent some of the slugging nature of the material. Diverting all rainfall not falling directly on the feedlot surface around the entire facility and maintaining lots so their litter remains as dry as possible were helpful in minimizing stream pollution potential.
(Christenbury-Iowa State)

0121 - C2

PHYSICAL PROPERTIES OF ANIMAL MANURES ASSOCIATED WITH HANDLING,
Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
A. T. Sobel.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 27-32. 5 tab, 8 fig, 11 ref.

Descriptors: *Physical properties, Bulk density, *Farm wastes, Liquid wastes, Particle size, *Poultry, *Cattle.
Identifiers: Volatile solids, Fixed solids, *Flowability, Freezing point, *Production.

This paper is concerned with various physical properties of chicken and dairy cow manure that have a relationship to handling. The properties are considered mainly from the standpoint of both fresh and diluted manure. The information reported was obtained from analysis concerned with the physical properties of animal manures and represents a summary of those properties which are specifically related to handling. These properties are: (a) basic physical composition, (b) particle density and bulk density, (c) production, (d) particle size and distribution, (e) dilution, (f) settling rate, (g) suspended and dissolved solids, (h) flowability, and (i) freezing point. (Christenbury-Iowa State)

0122 - B1, C1, D1

METHODS OF HANDLING POULTRY-WASTE MATERIAL,
Cornell Univ., Ithaca, N.Y. Dept. of Poultry Science.
C. E. Ostrander.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 32-33.

Descriptors: *Poultry, *Farm wastes, Waste storage, Waste disposal, Odors.
Identifiers: *Handling, High-density systems, Processing, Methods, Collecting.

This paper reports on manure handling methods employed in high-density poultry operations. Operations include: collecting, removal, storing, loading, spreading, processing and disposal. (See (Christenbury-Iowa State)

0123 - B2, C2, F1

PUMPING MANURE SLURRIES,
California Univ., Davis. Dept. of Agricultural Engineering.
S. A. Hart, J. A. Moore, and W. F. Hale.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 34-38. 22 fig, 2 tab, 5 ref. Public Health Research Grant EF-265.

Descriptors: *Pump testing, *Slurries, *Farm wastes, *Waste disposal, *Performance, Waste dilution, Efficiencies, Contrifugal pumps.
Identifiers: Handling, Capacity, Positive displacement, Diaphragm, Input horsepower, Selection criteria.

The purpose of this report was to analyze the performance characteristics of the different kinds of pumps under various conditions. Five pumps, representing centrifugal, positive displacement, and diaphragm types were tested. A pump was always tested with water first. Fresh manure was then mixed with the water to form a slurry. This was kept well mixed both by recirculation by the pump and by continuous mixing of the storage tank. Some 300 individual runs were made in testing the five pumps with three manures at various speeds. Dilution was more important than kind of pump, thin slurries being most satisfactory. Practical and economic conditions are discussed relating to pump selection. (Christenbury-Iowa State)

0124 - B2, C2

ENGINEERING PROBLEMS IN YEAR-ROUND DISTRIBUTION OF WASTE WATER,
Pennsylvania State Univ., University Park, Pa. Dept. of Agricultural Engineering.
E. A. My[illegible].
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 38-41. 1 tab, 2 fig, 6 ref.

Descriptors: *Sprinkling, *Distribution systems, *Sewage disposal, Farm wastes, Freezing, Winter, Distribution patterns.
Identifiers: Deflector stationary sprinklers, Year-round irrigation.

This paper presents some of the problems encoun-

tered which may be considered in the design, installation, and operation of irrigation systems for animal-waste disposal. The system used to distribute waste water at Penn State is first explained briefly. Then the problems encountered are discussed under the heading pumping, pipe system, and irrigation heads.
(Christenbury-Iowa State)

0125 - B1, C2

SLOPING FLOORS FOR BEEF-CATTLE FEEDLOTS,
California Univ., Davis.
S. R. Morrison, V. E. Mendel, and T. E. Bond.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 41-43. 3 tab, 4 fig, 3 ref.

Descriptors: *Cattle, *Farm wastes, Confinement pens, Performance, Disposal.
Identifiers: *Slatted floor, *Sloping floor, *Feedlots, Weight gains, Cattle behavior, Feed efficiency.

Limited tests on sloping floors for cattle feedlots indicate that slopes up to 7 deg do not depress weight gains or feed efficiency. A slope of about 5 deg is sufficient for removal of most of the manure, but unless some flushing arrangement is employed, manure will build up near the feed bunk. Stalls have little value in preventing this build-up. A slat-covered pit at the lower end of the slope allows manure to move freely off the floor and serves as a satisfactory storage. (Christenbury-Iowa State)

0126 - B3

MATERIALS HANDLING AND LABOR IN FREE-STALL AND LOOSE HOUSING,
Purdue Univ., Lafayette, Ind.
W. E. Schmisseur, C. M. Brown, Jr., J. L. Albright, W. M. Dillon, and A. C. Dale.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 43-45. 3 tab, 17 ref.

Descriptors: *Farm wastes, *Cattle, Disposal, Labor.
Identifiers: *Materials handling, *Free-stall, *Loose housing, Bedding.

In the winter and spring of 1964-65 Purdue University conducted two 6-month studies in Lafayette and Cuzco, Indiana, comparing free-stall to loose housing. For one free-stall comparison, 20 stalls were place in one-third of the area of each of two pole-type barns. The remaining areas were used for loose housing. Ninety cows were divided into four individual lots. Each free-stall unit housed 20 cows, with 25 cows in loose housing. All four lots were treated and handled similarly. Straw was used as bedding. Daily work sheets showing time used to bed the cows, scrape alleys, pounds of bedding used, and the pounds of manure removed daily were kept on all groups. Two pole-type barns were also used in the other free-stall comparison. One barn was used for loose housing; the other contained 32 free stalls; 26 animals were housed in each barn. Sawdust was used to bed all animals for half of the experiment; straw was used for the rest of the experiment. (Christenbury-Iowa State)

0127 - B1, D1, E1

CATTLE-MANURE HANDLING AND DISPOSAL SYSTEMS ON THE WEST COAST,
Washington State Univ., Pullman. Dept. of Agricultural Engineering.
E. H. Davis.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 45-47. 3 ref.

Descriptors: Cattle, *Farm wastes, *Farm management, Project planning, Environmental sanitation.
Identifiers: Loafing sheds, Liquid manure, *Health authorities, Alleyways, Holding tanks.

Stall housing, an acceptable practice, produces manure which requires special handling. The method of handling and disposing of manure in a sanitary manner depends on climatic conditions and management practices. Disposal of animal wastes is part of the livestock enterprise and should be charged to this operation. As animals and people get closer together in heavily populated areas, disposal of animal wastes in a sanitary manner becomes increasingly important. Close working relationships with state health departments is essential. Additional research is needed concerning lagoon, nitrate contamination of underground water supplies, grinding units for processing beef and dairy manures, and agitation equipment for large holding tanks. (Christenbury-Iowa State)

0128 - E1

MACERATION FOR DISPOSAL OF DEAD POULTRY,
California Univ., Davis. Dept. of Agricultural Engineering.
J. A. Moore, and W. C. Fairbank.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 47-49. 2 fig, 2 ref.

Descriptors: *Farm wastes, Disposal, Farm lagoons, Septic tanks, *Waste disposal, *Poultry, Equipment slurries.
Identifiers: *Macerator, Composting, Thin bed drying, *Equipment design.

The development of a macerator for dead poultry is reported. Several initial designs were investigated. Combining all the findings of the preliminary investigation in the final design of the second chopper-type macerator has led to the development of a satisfactory dead-bird macerator. Systems for disposal of the macerated poultry are discussed and evaluated. Slurry systems, lagoons, heated septic tanks, artificial composting, and thin bed drying were judged to be satisfactory for disposing fo the macerated poultry.
(Christenbury-Iowa State)

0129 - C2

WATER METABOLISM STUDIES MAY ASSIST WITH WASTE DISPOSAL,
Texas A and M Univ., College Station. Dept. of Poultry Science.
J. H. Quisenberry, D. D. Malik, and Ramon Ibarbia.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 49-51. 10 tab.

Descriptors: *Farm wastes, *Poultry, Waste disposal, Odor, Clays, Bentonite, Genetics, Confinement pens, Eggs diets.
Identifiers: Waste management, Water excretion, Drippings, Laying bird.

For many poultry operations, attempts to solve the waste-management problems can best be accomplished by concentrating on methods of obtaining dry or drying the droppings to a manageable level. Three methods have been tested and were reported in this paper. These are: (a) use of splashboards under cage operations, (b) genetic selection for low water excretors. Each of these has its appropriate place in bird management and should be used by poultrymen as their specific needs require. (Christenbury-Iowa State)

0130 - E2

DISPOSAL OF POULTRY MANURE BY PLOW-FURROW-COVER METHOD,
Rutgers - The State Univ., New Brunswick, N.J. Dept. of Agricultural Engineering.
Charles H. Reed.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 52-53. 1 tab, 4 ref.

Descriptors: *Farm wastes, *Poultry, *Waste disposal, Odor, Slurries, Furrows, Soil disposal fields.
Identifiers: *Waste management, *Plow cover, Liquid manure, Flies.

The disposal of liquid manure by the plow-furrow-cover technique appears to be an excellent conservation method. The upper soil layer is used as the disposal medium; there is no opportunity for flies to breed or even feed. In a closed handling system there are no detectable odors. With this method from 1 to 2 in. of slurry is deposited in a plowed furrow 6 to 8 in. deep. Immediately after deposition, a single-bottom plow covers the manure, making the next furrow; this can be done in one or two operations. Depositing and completely covering 2 in. of slurry, equivalent to 225 tons per acre, has been very successful. This paper describes the development of the method, the initial disposal programs, and the proposed experimental program to determine the maximum rate of disposal on a limited land area. (Christenbury- Iowa State)

0131 - E2

DISPOSAL OF HOUSEHOLD WASTES IN THE SOIL,
Southern Illinois Univ., Carbondale; and Ohio State Univ., Columbus.
J. H. Jones, and G. S. Taylor.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 53-55. 1 tab, 2 fig, 5 ref.

Descriptors: *Farm wastes, *Septic tanks, *Sewage disposal, *Conductivity, Soil disposal fields, Sewers, Construction, Absorption, Rural areas.
Identifiers: *Soil absorption, *Soil clogging, Household wastes.

Generally the most satisfactory method of disposing of human excreta and household wastes in rural areas is the septic tank soil sbsorption system. While studies show that this is a safe system of household wastes disposal, many systems are malfunctioning; a high percentage of these failures is due to soil absorption difficulties. Thus the utility of the system depends on the size of the absorption field, the waste load, soil conditions, and the construction and installation of the absorption field. This paper discussed the criteria that should be used when designing a septic-tank system. The factors affecting the satisfactory operation of the system are presented. Construction and installation practices are examined. Conditions affecting soil clogging are presented along with conductivity vs cumulative outflow graphs.
(Christenbury-Iowa State)

0132 - C4, D4

REQUIREMENTS FOR MICROBIAL REDUCTION OF FARM ANIMAL WASTES,
South Dakota State Univ., Brookings. Dept. of Bacteriology.
Edward C. Berry.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 56-58. 2 tab, 1 fig, 13 ref.

Descriptors: *Farm wastes, *Lagoons, *Biodegradation, *Sewage bacteria, Odor, Anaerobic conditions, Aerobic conditions, E. coli, Bac-

teria, Fungi, Actinomycetes, Protozoa, Algae.
Identifiers: *Chemical environment, *Physical environment, Phage, Fermentor, Facultative, Microaerophilic, Inoculation.

The cardinal principle on which all sanitation reduction work is based is to provide an environment in which the micro-organisms can bring about conversion of undesirable material to a non-offensive and stable state in the shortest possible time. To bring this about it is necessary to consider (a) the wastes we want reduced and their end products and (b) the organisms that we want to perform this chore for us. The micro-organisms involved in manure reduction are to be found in the following groups: (a) bacteria (aerobic, anaerobic, microaerophilic, facultative or obligate), (b) fungi, (c) actinomycete, (d) protozoa, (e) algae, and (f) phage. Each organism finds its optimum environment under fairly restricted environmental conditions. This paper gives examples of the most common micro-organisms and the effect the environment has on their activity.
(Christenbury-Iowa State)

0133 - D4
AEROBIC TREATMENT OF SWINE WASTE,
Illinois Univ., Urbana.
R. L. Irgens, and D. L. Day.
Laboratory study is reported in more detail in 'Journal of Agricultural Engineering Research', 11: (1) 1-10, 1966, R. L. Irgens and D. L. Day. Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 58-60. 8 fig, 3 tab.

Descriptors: *Farm waste, *Aerobic treatment, *Aeration, Biochemical oxygen demand, Chemical oxygen demand, Oxidation.
Identifiers: Swine waste, Waste collection pits, Slotted-floor, Oxidation ditch.

From the results of these tests, it was calculated that for aerobic stabilization of the waste, about 6 cu. ft. of tank volume per pig would be required and approximately 1.2 lb 02 per lb of BOD (0.65 lb BOD per 125-lb pig per day), or 2500 cu. ft. of air pen lb of BOD at 3 per cent efficiency of oxygen utilization. The aerobic process for treating swine waste is odor-free and does not attract flies. The only gas that is produced is carbon dioxide which to a large extent will remain in solution as bicarbonate. The organic matter that is not oxidized to carbon dioxide and water is converted to stable solids, which are easily dewatered and dried on a sand bed. The effluent has a low BOD and is free from ammonia. It seemed feasible to develop an oxidation ditch inside a swine production bulding utilizing self-cleaning slatted floors.
(Christenbury-Iowa State)

0134 - B2, D4
OPERATING CHARACTERISTICS OF TWO AEROBIC-ANAEROBIC DAIRY MANURE TREATMENT SYSTEMS,
Massachusetts Univ., Amherst. Dept. of Agricultural Engineering; and New Holland Machine Co., Pa.
N. W. Webster, and J. T. Clayton.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No. SP-0366, Michigan State University, May 1966, p 61-65. 2 tab, 14 fig, 20 ref. USDI water research act of 1964 (Public Law 88-379).

Descriptors: *Farm wastes, *Anaerobic conditions, *Aerobic conditions, *Aeration, Sedimentation, Dissolved oxygen, Biochemical oxygen demand.
Identifiers: *Dairy manure, Aerators, Aeration tanks, Sedimentation tanks, Systems, Volatile solids.

Two aerobic waste-treatment systems were designed and tested for use in treating dairy manure. The systems were combinations of aeration and settlement for the purpose of reducing the pollution capabilities of the waste and to make it possible to use the treated effluent for transporting the fresh waste. The system utilizing anaerobic primary settlement and secondary aeration system was selected as the best suited for agricultural use. A system using primary aeration with secondary settlement did not operate satisfactorily.
(Christenbury-Iowa State)

0135 - C1, D4
TRICKLING FILTERS AS A DAIRY-MANURE STABILIZATION COMPONENT,
Massachusetts Univ, Amherst.
D. O. Bridgham, and J. T. Clayton.
Manage Farm Animal Wastes, Amer Soc Agr Eng, St. Joseph, Mich, pp 66-68, 1966. 3 p, 6 fig, 3 tab, 9 ref. OWRR Project A-009-MASS.

Descriptors: *Trickling filters, Filters, *Waste treatment, Sewage effluents, *Farm wastes, Effluents, Settling Basins, *Cattle, *Dairy industry, Wastes, Biochemical oxygen demand, Pollution abatement.

Trickling filters are an effective means of reducing the polluting qualities of dairy manure and a possible means of treating effluent for discharge or recirculation. Loading rate and waste temperature have a great effect on the quality of the effluent. Nine points were plotted for this experiment and labeled according to average BOD of the effluent under respective conditions. Assuming a linear relationship between points, a topograph was drawn for various qualities of effluent. With bubbling aeration, a 1000-lb cow would require 334 cu ft of storage and treatment volume for 6 months of operation between sludge removals. An aeration tank, 134 cu ft in volume, was operated at 95 deg F. The estimated size for 70 deg F operation was 200 cu ft. Experiments support Webster's value for sizing primary sedimentation tanks of 200 cu ft per cow for biannual sludge removal. Test results show the volume of trickling filter required per cow to meet specific temperatures and effluent qualities. Experiments suggest a sedimentation tank volume of about 114 cu ft per cow instead of the 248 cu ft actually used. Therefore, a trickling filter system would require from 346 to 391 cu ft of tanks per cow to produce an effluent BOD of 200 ppm.

0136 - D4
ON-SITE COMPOSTING OF POULTRY MANURE,
Auburn Univ., Ala. Dept. of Agricultural Engineering.
J. R. Howes.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 68-69.

Descriptors: *Farm wastes, *Poultry, *Aerobic conditions, Microorganisms, Peat, Cellulose, Aerobic treatment.
Identifiers: *Composting, Fecal material, *Litter, Heat of composting, *Litterlife.

Although composting dates back to antiquity, the composting of poultry litter in situ is new. A culture of 46 species of micro-organisms was mixed into a base of peat and various minerals. This active mixture was spread at the rate of 1/2 lb. per sq. ft. on poultry litter that was at least 6 in. deep and contained an appropriate balance of cellulose and fecal material. Water used to clean the house interior was added to the litter and then mechanically mixed to initiate aerobic action. After heat of composting had subsided, birds were placed on the litter. This process is relatively inexpensive. It overcomes problems associated with obtaining and disposing of litter; provides odor and fly-free environments; permits birds to be safely replaced on the same litter shortly after diseased stock has been removed or the houses flooded; permits humidification of poultry houses; keeps dust to a minimum and enables house interiors to be washed, thus increasing sanitation and equipment efficiency.
(Christenbury - Iowa State)

0137 - B2, C1, D4
PRIMARY TREATMENT OF SWINE WASTES BY LAGOONING,
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
T. L. Willrich.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 70-74. 2 fig, 7 tab, 14 ref. U. S. Public Health Research Grant EF00410.

Descriptors: *Farm wastes, *Anaerobic conditions, *Design criteria, *Performance, Lagoons, Anaerobic bacteria, Chromatium, Rhodothece, Odor, Gases, Sludge.
Identifiers: *Sludge accumulation, *Swine wastes, *Waste treatment lagoons, *Anaerobic lagoons, Micro lagoons, Lagoon feeding, Gas production, Odor production.

A brief history of lagooning at Iowa State University is presented. The design and problems associated with operation of the lagoon are presented. Data was taken over a period of 8 years to arrive at recommendations for construction of lagoons. Factors discussed include: detention times and sludge accumulations, loading rates, lagoon performance, gas production, odor production, micro-lagooning, lagoon feeding, and design criteria. The recommended design criteria are: (1) For anaerobic lagoons which will receive fairly uniform and frequent (one-a-week or less) loadings: allow a minimum of 1 cu. ft. of lagoon water volume per pound of total animal weight confined in a hog-finishing building, plus additional lagoon volume for sludge storage. (2) For lagoons which will recieve non-uniform and intermittent loading: allow a minimum of two cu. ft. of lagoon water volume per pound of total animal weight confined in a hog-finishing building, plus additional lagoon volume for sludge storage.
(Christenbury-Iowa State)

0138 - B2, C1, D4
DESIGN CRITERIA FOR ANAEROBIC LAGOONS FOR SWINE MANURE DISPOSAL,
Nebraska State Dept. of Health, Lincoln.
David R. Curtis.
Proceedings National Symposiun on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 75-80. 5 fig, 5 tab.

Descriptors: *Farm wastes, *Anaerobic conditions, *Chemical oxygen demand, *Biochemical oxygen demand, *Odor, *Hydrogen ion concentration, Lagoons, Temperature, Oxidation-reduction potential, Alkalinity.
Identifiers: *Kjeldahl nitrogen, *Volatile acids, *Swine waste, Anaerobic lagoons.

On-site investigations were conducted at 10 selected lagoons to confirm data collected through questionnaires and to observe the actual operation. Data collected included: Number of swine served, sketch of the plan and elevation views, chemical data on samples collected at various times during the study, and a typical cross section of the lagoons showing how solids have accumulated. The temperatures in the lagoons ranged from 70 to 80 F, with temperatures of 75 F and above more prevalent. Oxidation reduction potential (ORP) data indicated that anaerobic conditions were present at all times in the lagoons. Chemical analyses have proved to be effective diagonostic in-

struments in evaluating the probable cause of objectional odors from lagoon installations. The determinations of greatest significance were pH, Kjeldahl nitrogen, volatile acids, alkalinity, BOD and COD. Design criteria for hog lagoon installations for Nebraska are given. Operational procedures are outlined that should improve the chances for successful lagoon operations.
(Christenbury-Iowa State)

0139 - D1

CATTLE-MANURE TREATMENT TECHNIQUES,

Kansas Univ., Lawrence. Dept. of Civil Engineering.
R. W. Agnew, and R. C. Loehr.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 81-84. 1 fig, 5 tab, 10 ref.

Descriptors: *Farm wastes, *Lagoons, *Anaerobic digestion, *Aeration, Activated sludge, Solid wastes, Runoff, Chemical oxygen demand, Biochemical oxygen demand, Laboratory tests, Alkalinity.
Identifiers: *Waste characteristics, *Polishing unit, *Anaerobic lagoons, *Aeration systems, Settled solids, Solids handling, Solids disposal, Runoff control, Volatile acids, Kjeldahl nitrogen.

The characteristics of commercial lagooning operations were discussed. It was pointed out that there was a need for extensive planning in the design and operation of lagoons. It was suggested that a combination of an anaerobic lagoon and an aeration unit may be most practical for most installations. Data was presented and discussed concerning the characteristics of anaerobic lagoons, aeration systems, and the settled solids. A potential treatment facility was proposed and discussed as to the cost, colids handling, solids disposal, efficiency, and runoff control. (Christenbury-Iowa State)

0140 - D2

DEWATERING CHICKEN MANURES BY VACUUM FILTRATION,

Clarkson Coll. of Technology, Potsdam, N.Y., and New York State Dept. of Health, Albany.
E. A. Cassell, A. F. Warner, and G. B. Jacobs.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 85-91. 5 tab, 9 fig, 32 ref. N.Y. State Dept. of Health (Contract No. C-18768).

Descriptors: *Farm wastes, *Sludge treatment, *Poultry, *Dewatering, Laboratory tests, Sewage sludge, Filtration, Municipal wastes.
Identifiers: *Sludge conditioners, *Vacuum filtration, Chemical-sludge conditioners, Conditioner dosage, Liquid requirements, Solids demand.

The sludge conditioning and vacuum filtration characteristics of sewage sludges and chicken manures were found to be vastly different. Most of the sewage sludges were dewatered with FeC13, FeC13 and lime coubinations, cationic polyelectrolyte, and non-ionic polyelectrolyte sludge conditioners. None of these effectively promoted the dewatering of chicken manures. On the other hand, the anionic polyelectrolyte effectively dewatered chicken manure, but not the sewage sludges. The anionic polyelectrolyte can reduce the specific resistance of chicken manures by as much as a factor of 15 and produce filter cakes with as high as 25 percent total solids. (Christenbury-Iowa State)

0141 - D2

REMOVAL OF MOISTURE FROM POULTRY WASTE BY ELECTRO-OSMOSIS (PART I),

Nebraska Univ., Lincoln. Dept. of Agricultural Engineering.
Otis E. Cross.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 91-93. 7 fig.

Descriptors: *Farm wastes, *Dewatering, *Electro-osmosis, Laboratory tests, Cathodes, Poultry.
Identifiers: Moisture distribution, Expelling water.

This investigation was designed to determine the effectiveness of expelling water from poultry excrement by the electro-osmosis phenomena. Three factors were selected as being the most critical: amount of electric current, time, and distance between electrodes. Twelve plastic tubes were placed in a horizontal position. Each tube was 2 in. ID and 65 cm. long. The piston-type anode was carbon and maintained constant pressure upon the excrement sample by means of a weighted-lever arrangement. The cathode was a 1 mm. copper screen. The tests were conducted with three sample lengths: 40, 25, and 10 cm. The electro-osmosis phenomena produced a 57 percent decrease in moisture content. The amount of expelled water was a function of current flow, time, length of sample, and moisture content of the sample.
(Christenbury-Iowa State)

0142 - D2

REMOVAL OF MOISTURE FROM POULTRY WASTE BY ELECTRO-OSMOSIS (PART 2),

Michigan State University, East Lansing. Dept. of Agricultural Engineering.
F. V. Nurnburger, C. J. Mackson, and J. Davidson.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 93-95. 7 fig.

Descriptors: *Farm wastes, *Electro-osmosis, *Dewatering, Poultry.
Identifiers: *Joule heating, *Gravity flow, Current flow.

This investigation was undertaken to study the effects of various electrode materials on the liquid expelled from chicken excrement by the process of electro-osmosis. It utilized the effects of joule heating and gravity flow. The results from using 5, 10, 15, and 20 v d-c were that 20 v d-c gave the best results. Of the three materials used, stainless steel gave the best performance, copper was the poorest, and steel was intermediate. The maximum moisture-content reduction was 4.8 percent wb based on 22 hr. of operation at 20 v. This was not sufficient to reach a pelletable level from the initial value of 80 percent wb. The cost of the electric energy used was 12.7 cent per gallon of liquid removed based on the rate of 2 cent per Kw-hr.
(Christenbury-Iowa State)

0143 - D2, E4

DESTRUCTION OF CHICKEN MANURE BY INCINERATION,

Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
A. T. Sobel, and D. C. Ludington.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 95-98. 2 tab, 4 fig, 12 ref. N.Y. State Department of Health (Contract No C18965).

Descriptors: *Farm wastes, *Incineration, Poultry, Laboratory tests, Heat balance, Natural resources.
Identifiers: *Combustion, *Solid fuels, Volatile solids, Mass balance, Fixed carbon, Ash, Heat of combustion, High heat value, Low heat value, Energy balance.

The volatile solids in chicken manure represents considerable energy. Incineration is a process which utilizes this energy for destruction of the organic portion of the manure. The application of existing combustion theory to the incineration of chicken manure is difficult beacuse of lack of basic property information and the variability of the material. The incineration process is very dependent on the moisture content of the manure. A laboratory incinerator has been constructed to investigate the incineration process. Initial trials of the incinerator have been restricted to partially dried manure. Considerable information has been obtained. Future application of incineration will depend on cost factors and possible air pollution hazards. A mass and heat balance for a typical incineration trial is given in an Appendix to the paper. (Christenbury-Iowa State)

0144 - A2, C1, D1

TREATMENT OF DUCKWASTES AND THEIR EFFECTS ON WATER QUALITY,

Virginia State Water Control Board, Richmond.
R. V. Davis, C. E. Cooley, and A. V. Hadder.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 98-105, 10 tab, 7 ref.

Descriptors: *Farm wastes, *Coliforms, *Poultry, *Oysters, *Water quality, Salmonella, Biochemical oxygen demand, Environmental effects, Settling basins.
Identifiers: *Rappahannock River, Pilot pond, Barnhardt Farms, Inc., MPN (Most probable number), Raw wastes, Duck run.

Early in 1963 a six-month study was undertaken to determine the effect of coliform organisms in the treated wastes from two duck farms on water quality in an oyster-producing and recreational area of the Rappahannock River near Urbanna, Virginia. Before the treatment facilities were installed, water quality in the area was questionable for recreation purposes and was restricted for direct marketing of shellfish. Treatment consists of alternately used earthen settling basins for removing solids, followed by 4-day retention earthen basins. These remove essentially all settleable solids and reduce the most probable number of coliform organisms per 100 ml. by 90 to 95 percent. On the basis of data collected from the river, restrictions from the public oyster beds were lifted. Satisfactory recreational water quality now exists throughout the area, except very near the discharges.
(Christenbury-Iowa State)

0145 - E3

VALUE OF BROILER LITTER AS FEED FOR RUMINANTS,

Virginia Polytechnic Inst., Blacksburg; Cornell Univ., Ithaca, N.Y.; and Kansas State Univ., Manhattan.
J. P. Fontenot, A. N. Bhattachanya, C. L. Drake, and W. H. McClure.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 105-108. 7 tab, 11 ref.

Descriptors: *Farm wastes, *Poultry, *Sheep, *Cattle, *Feeds, Proteins, Metabolism, Ruminants, Feeding rates.
Identifiers: Nutritive value, Broiler litter, Digestible protein, Digestible energy, Metabolizable energy, Total digestible nutrients, Carcass grade, Rate of gain.

Information has been presented concerning the nutritive value of broiler litter for ruminants. The litter samples analyzed contained an average of 32 percent crude protein, dry basis. In autoclaved litter, true protein accounted for 45 percent of the total nitrogen. In metabolism trials with wethers, 25 and 50 percent autoclaved peanut-hull and wood-shaving broiler litters replaced corresponding amounts of a corn-hay ration. There were no sig-

nificant differences in digestible protein, digestible energy, metabolizable energy, and TDN content between kinds and levels of litter. Average values were 22.7 percent, 2440 kcal per kg, 2181 kcal per kg, and 59.8 percent, respectively. It was found in fattening trials that rate of gain and carcass grade were not significantly different for beef steers fed mixtures containing 25 percent ground peanut-hull or wood-shaving broiler litter than for those fed a conventional fattening mixture.
(Christenbury-Iowa State)

0146 - E3

UTILIZATION OF ANIMAL WASTE AS FEED FOR RUMINANTS,
Auburn Univ., Ala. Dept. of Animal Science
Aw. brady Anthony
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 109-112. 13 tab, 23 ref.

Descriptors: *Farm wastes, *Cattle, *Chemical analysis, Feeds, Silage, Nutrients, Amino acids, Vitamins.
Identifiers: *Feedlot manure, *Steers, *Digestion coefficients, *Average daily gain, Manure, Carcass data.

Analysis of feedlot manure showed it to be a valuable source of vitamins and amino acids. Washed manure was mixed with a concentrated feed and successfully fed to steers. When unwashed manure was combined with a concentrated mixture or with silage and fed to steers, animal gain and feed efficiency were not improved. Fresh feedlot manure proved to be a valuable ration component when it was either washed or autoclaved. Fresh feedlot manure was blended with coastal bermudagrass hay to make a palatable and nutritious low-moisture silage. (Christenbury-Iowa State)

0147 - B1, E3

COPROPHAGY AND USE OF ANIMAL WASTE IN LIVESTOCK FEEDS,
Texas Tech. Univ., Lubbock.
R. M. Durham.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 112-114. 6 tab.

Descriptors: *Farm wastes, *Feeds, *Livestock, Poultry, Cattle, Catfishes, Sheep, Swine, Eggs.
Identifiers: *Coprophagy, *All-concentrate ration, Feedlot steers, Digestion coefficient.

This paper reports observations of coprophagy in cattle consuming an all-concentrate ration and the feeding of rations containing manure from these cattle to poultry, cattle, swine and catfish. The all-concentrate ration was composed of 89% ground milo, 10% cottonseed meal and 1% vitamin-mineral supplement. The manure was ground in a hammer mill without prior drying and mixed with other ration ingredients for feeding. Coprophagy has been observed in cattle consuming limited quantities of the all-concentrate ration. All-concentrate cattle manure has been successfully fed to growing pullets and laying hens. The all-concentrate manure has been fed to feedlot steers with generally favorable results to limit feed consumption. Catfish can make rapid gains on feedlot manure if care is taken to prevent oxygen depletion. (Christenbury-Iowa State)

0148 - E3

ROLE OF THE RENDERER IN THE USE AND DISPOSAL OF ANIMAL WASTES,
Triangle E By-Products Co., Harrisonburg, Va.
E. L. Foerster, Sr.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 114-117.

Descriptors: *Farm wastes, Poultry, Cattle, Chemical analysis, Economics, Disposal, Equipment, Digestion tanks, Nutrients.
Identifiers: *Rendering, *Fallen stock, Protein content, Coprophagy.

Mr. Foerster gives a general history of the rendering industry in the United States. He explains the role of the industry in disposing of fallen animals. He gives an analysis for a typical product from a rendering plant. Some data is presented concerning the economics of the rendering process. Through cooperation, the rendering plant can provide a useful and efficient service in disposing of fallen stock.
(Christenbury-Iowa State)

0149 - D4

EVALUATING ADAPTABILITY OF PASTURE GRASSES TO HYDROPONIC CULTURE AND THEIR ABILITY TO ACT AS CHEMICAL FILTERS,
Agricultural Research Service, Beltsville, Md.; and Maryland Univ., College Park.
Harry J. Eby.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 117-120. 6 fig.

Descriptors: *Farm wastes, *Hydroponics, *Effluents, Nutrients, Municipal wastes, Lagoons, Grasses, Aquatic environment, Root development, Light penetration.
Identifiers: Plant-nutrient removal percentage, Fertilizer value, Nutrient extraction potential, Surface area.

The possibility of using hydroponics as a means of removing nutrients from sewage-treatment plants and lagoons is discussed. Several grasses were studied with rye and tall fescue showing the most promise. Data is presented in graph form showing the plant-nutrient removal percentages. Two appendices are given. Appendix I shows the projected yield capabilities of the various forage grasses with the nutrient-extraction potential based on laboratory-scale sampling. Appendix II shows the method for computing the size of the hydroponic system required for any given volume of effluent.
(Christenbury-Iowa State)

0150 - B1, F1

PROBLEMS OF CATTLE FEEDING IN ARIZONA AS RELATED TO ANIMAL-WASTE MANAGEMENT,
Arizona Univ., Tucson. Dept. of Agricultural Economics.
Thomas M. Stubblefield.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 120-122. 11 ref.

Descriptors: *Farm wastes, *Cattle, *Legal aspects, Relocation, Area development, Odor, Arizona.
Identifiers: *Cowtowns, *Feedlots, Metropolitan areas, Manure.

Problems associated with locating large numbers of cattle near metropolitan areas are discussed. The particular problems with large feeders in Arizona and their solutions are presented. Feedlot manure selling for as high as $5 per ton in the 1940's now is a liability costing $1 to $1.50 per ton to remove. It has been advantageous for the feedlots to relocate near farming areas for more efficient disposal of the manure. To circumvent problems with residential areas, 'cowtowns' are being developed. (Christenbury-Iowa State)

0151 - B2, D1, E1, F1

ECONOMIC EVALUATION OF LIQUID-MANURE DISPOSAL FOR CONFINEMENT FINISHING OF HOGS,
Illinois Univ., Urbana. Dept. of Agricultural Economics.
Richard P. Kesler.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 122-125. 6 tab, 2 ref.

Descriptors: *Farm wastes, *Swine, *Disposal, *Economics, *Annual cost, Lagoons, Storage capacity, Size, Nutrients, Ultimate disposal, Liquid wastes.
Identifiers: Manure, Total lagooning, Hauling and spreading, Recovery rate, Fertilizer nutrients, Salvaged nutrients.

Manure is a valuable by-product of the hog industry. This manure must be disposed of on the land to obtain its inherent value. Factors that should be considered in choosing a manure disposal system are (a) amount of manure that is produced, (b) fertility content of the manure and its value as a replacement for commercial fertilizer, (c) disposal costs of each system, and (d) availability of cropland on which to spread the manure. An extensive economic analysis of three disposal systems is presented: (I) Total hauling and spreading, (II) Total lagooning, and (III) Partial hauling and spreading and lagooning. Three sizes of hog operation were considered in the comparison: 500, 1500, and 2500 head. (Christenbury-Iowa State)

0152 - B2, D1, E1, F1

ECONOMICS OF LIQUID-MANURE DISPOSAL FROM CONFINED LIVESTOCK,
Purdue Univ., Lafayette, Ind. Dept. of Agricultural Economics.
W. H. M. Morris.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 126-131. 6 tab, 1 fig, 16 ref.

Descriptors: *Farm wastes, *Cost analysis, *Disposal, *Value, *Nutrients, Chemical oxygen demand, Biochemical oxygen demand, Cost comparison, Economic feasibility, Economics, Anaerobic conditions, Aerobic treatment, Liquid wastes, Irrigation.
Identifiers: *Production model, Losses in storage, Value of manure, Utilization, Oxidation ditches.

Some of the problems in estimating the costs and returns from handling manure have been discussed. Removal of the manure from the livestock production areas has not been discussed. In general, the scale and efficiency of the operation and prevention of dilution of the manure determine if the manure can be spread in the fields at a cost equal to or less than the value of the nutrients used by the crop. Aerobic and anaerobic treatment of manure in special low-cost facilities designed for use on the farm seem to be practical solutions. No profitable method of industrial utilization of livestock manure can be forseen. (Christenbury-Iowa State)

0153 - E3

POULTRY MANURE MARKETING,
Pennsylvania State Univ., University Park.
Herbert C. Jordan.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 132-133.

Descriptors: *Farm wastes, *Marketing techniques, Fertilizers, Poultry analysis, Value, Economics.
Identifiers: *Bagging, *Processing.

A survey was conducted between 1961 and 1963 concerning marketing poultry manure. Information concerning the following topics was collected: General, Bagging Manure, Processing, Supplemental Mixture, and Marketing. Cost associated with bagging and minimum analysis (nitrogen, phosphoric acid, potash) is given for bags ranging from 2.5 to 80 pounds per bag. A summary of the data is presented pointed out that fresh manure is worth about $5 a ton to the soil ($20 per ton on a dry weight basis). Poultry manure used as an organic soil conditioner is and perhaps will remain the greatest and most common use of poultry manure. (Christenbury- Iowa State)

0154 - F4

FARM-WASTE MANAGEMENT TRENDS IN NORTHERN EUROPE,
Minnesota Univ., St Paul. Dept. of Agricultural Engineering.
E. P. Allred.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 133-136. 1 fig.

Descriptors: *Farm wastes, *Disposal, Equipment.
Identifiers: *Northern Europe, Family-size farm, Oxidation ditches, Disposal practices.

Farmers throughout most of northern Europe are faced with many of the same waste-disposal problems as those confronting American farmers. Methods and equipment used for waste disposal are discussed with emphasis on the 'family-size' farm. Those individuals working with oxidation ditches are quite optimistic with its performance. When one compares rural waste-disposal practices in Europe with those in America, there are noticeable differences in both equipment and methods. Surprisingly the greatest differences occur, however, in the people themselves and their attitude toward rural waste disposal. (Christenbury-Iowa State)

0155 - B2, C5, E2

PLANT RESPONSE TO MANURE NUTRIENTS AND PROCESSING OF ORGANIC WASTES,
Forschungsanstalt fuer Landwirtschaft, Brunswick (West Germany).
Cord Tietjen.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 136-140. 3 tab, 9 fig, 12 ref.

Descriptors: *Farm wastes, *Liquid wastes, *Nutrients, Urine, Nitrogen cattle, Swine, Fertilizers.
Identifiers: *Gulle, *Plant response, Plant nutrients, Manuring, Feces.

To produce gulle (liquid manure) from cattle feces and to apply it for manuring, the grassland has for a long time been the common way of disposal of animal waste in the Alpine foreland. New labor-saving barn arrangements, tools and implements promote the practice of gulle utilization both for grassland and cropland. It was learned by field and pot experiments that gulle can exert a strong influence on plant growth. The physiological efficiency of gulle nitrogen is several times higher than that of nitrogen in common barnyard manures. Range of variation is great depending on gulle processing and composition. Quality of manure, its contents and ratio of plant nutrients depend on kind of animals, individual properties of animals, feeding, dilution by water or other additives, barn arrangement, collection and storage facilities. It is recommended that animal excrement be processed to a standardized manure - a full gulle that can be characterized by its ratio of plant nutrients. (Christenbury-Iowa State)

0156 - D4

BIOLOGICAL TREATMENT OF ANIMAL WASTES,
Netherlands Rijkswaterstaat, Arnhem.
Henri M. J. Scheltinga.
Proceedings National Symposium on Animal Waste Management, ASAE Publication No SP-0366, Michigan State University, May 1966, p 140-143. 7 tab, 3 fig, 10 ref.

Descriptors: *Farm wastes, *Activated sludge, *Biological treatment, Swine, Laboratory tests, Nitrogen, Cost, Biochemical oxygen demand.
Identifiers: *Nitrogen balance, *Holland, *Oxidation ditch, Nitrification, Bio-industries.

This paper discussed treatment of farm wastes in Holland. Chemical and mechanical treatment alone have not proven satisfactory. Laboratory and full scale treatment experiments have been conducted. Aeration, anaerobic decomposition, activated sludge treatment, and oxidation ditch experiments have been performed. Foaming has been experienced in some tests. Nitrification and nitrogen balance for farm wastes are discussed. The cost associated with the treatment facilities were considered. (Christenbury- Iowa State)

0157 - F4

ANIMAL WASTE MANAGEMENT.
Cornell Univ., Ithaca, N.Y.

R. C. Loehr, Editor. In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, January 13-15, 1969. 414 p.

Descriptors: *Farm wastes, *Hogs, *Cattle, *Water pollution, *Air pollution, Soil contamination, Rates of application, Poultry, Sheep, Biochemical oxygen demand, Chemical oxygen demand, Dissolved oxygen, Hydrogen ion concentration, Oxidation Lagoons, Lagoons, Aeration, Soils, Moisture content, Fertilizers, Nitrogen, Phosphorus, Potash, Economics, Legal aspects, Legislation, Water quality act, Water table, Odors, Rotors, Aerobic conditions, Anaerobic conditions, Digestion, Antibiotics, Irrigation, Oxygen, Rotations, Hydrology, *Waste water treatment.
Identifiers: *Oxidation ditch, Land disposal, *Feedlots, *Confinement, Population equivalent, Slatted floors, Decomposition.

The increase in high density confined animal production operations in the past decade has led to a number of environmental quality problems, such as air and water pollution. The 1969 Conference attempted to bring knowledgeable individuals from many disciplines together to mutually discuss various aspects and potential solutions to the animal waste management problem. Forty-six papers, reports, and speeches are presented in the proceedings. Such diverse topics as hydrology, economics, odor measurement, lagooning, aerobic digestion, and land disposal are presented. Research and studies in many fields are reported. (White-Iowa State)

0158 - F3

REFLECTIONS ON POLLUTION CONTROL,
Zurn Industries, Inc., Washington, D.C.
Leon W. Weinberger.
In: Animal Waste Management, Proceedings, Cornell University, Conference on Agricultural Waste Management, p 1-3, 1969.

Descriptors: *Farm wastes, *Water pollution, *Water quality, *Cost-benefit ratio, Water pollution control, Environment, Waste water treatment.
Identifiers: *National policy, National misconception.

Dr. Weinberger expresses three personal viewpoints dealing with national policy on water pollution control, cost benefit analysis in water pollution control, and finally comments on the greatest myth or misconception in water pollution control. This national misconception being that we do not know how to solve the problems of water pollution control. Dr. Weinberger asks everyone to speak out and be heard on the way that you want to have our environment. (White-Iowa State)

0159 - F4

ENVIRONMENTAL POLLUTION--NOW AND IN THE YEARS AHEAD,
Office of Science and Technology, Washington, D.C.
Donald R. King.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, p 4-8, 1969.

Descriptors: *Farm wastes, *Environment, Legal aspects, Research and development, Design standards, Waste treatment, Waste disposal.
Identifiers: *Agricultural Pollution, Resource conservation, Waste uses, Land planning.

The report points out several avenues that warrant research attention; among them the following: (1) The potential benefits to control which may result from changing the character of animal wastes. (2) Information is needed on present control approaches to make them more generally applicable. (3) The tremendous volume of animal wastes produced necessitates the development and application of new and more effective treatment and disposal methods. (4) Additional attention to potential uses for animal wastes would be desirable. (5) Land use planning also warrants emphasis. (6) Additional information also will be needed on the relationships of wastes to agricultural production which can be used to assist in establishing standards. (White-Iowa State)

0160 - A2, B1, D1, F1

EFFECTS OF WATER QUALITY STANDARDS ON THE REQUIREMENTS FOR TREATMENT OF ANIMAL WASTES,
Federal Water Pollution Control Administration, Washington, D.C.
Harold Bernard.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 9-16. 1 tab, 2 fig, 5 ref.

Descriptors: *Farm wastes, *Legal aspects, *Water quality act, Biochemical oxygen demand, Chemical oxygen demand, *Water quality standards, Municipal wastes, Industrial wastes, Waste water treatment.
Identifiers: FWPCA, Animal feedlot, *Disposal requirements, *Waste treatment standards, Environmental backlash, Interstate waters.

Changes that have taken place in water quality standards are discussed. The purpose of the standards is to: (a) provide an engineering base for the design of waste treatment works by municipalities and industries without uncertainties in waste disposal requirements in interstate waters. (b) Serve as a clear public (local) policy statement on the use or uses to which specific segments of interstate waters may be put after due consideration of all the factors delineated above. The effect of these changes in standards is discussed with relation to the treatment of animal wastes. Future municipal B.O.D. loads and their subsequent treatment costs are brought out. It is mentioned that the FWPCA is interested in receiving proposals to demonstrate new or unique treatment and control techniques for animal wastes, especially in conjunction with an on-going operation. Only with the cooperation and leadership of the industry itself can techniques be developed to meet the various water quality standards and enable the industry a growth unimpeded by any environmental backlash. (White-Iowa State)

0161 - B1, F3

THE CHALLENGE OF ANIMAL WASTE MANAGEMENT,
Cornell Univ., Ithaca, N.Y.
Raymond C. Loehr.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 17-22. 5 ref.

Descriptors: *Farm wastes, Odors, Waste water treatment.
Identifiers: *Animal production, *Waste management, Environmental quality, Interrelationships of animal production, Study and research.

There is a woeful lack of understanding of the interrelationships between various aspects of animal production and waste management. It is to this point and to these relationships that this paper is addressed. The long term approach for animal production must be based upon not only optimal production of the product, but also on management of the entire production scheme such that it is consistent with the maintenance of acceptable environmental quality not only to the animals, and to the producers, but to society as a whole. The problem of animal waste management is actually many problems. It consists of technical, economic, social, educational, and perhaps above all, a communications problem. The talents of individuals from many disciplines are needed to produce better solutions to the problem. We need to initiate more studies that will take an overview of the animal production operation, feasible waste management systems, and their interrelationships. These studies should develop information that can be used as predictive and/or decision making tools to anticipate and minimize problems that may result. Herein lies the greatest challenge of animal waste management. (White-Iowa State)

0162 - D1, F4

THEORY AND FUTURE OUTLOOK OF ANIMAL WASTE TREATMENT IN CANADA AND THE UNITED STATES,
Toronto Univ. (Ontario). Dept. of Civil Engineering.
P. H. Jones.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 23-36. 2 tab, 27 ref.

Descriptors: *Farm wastes, *Biochemical oxygen demand, *Biological treatment, *Oxygen, Water pollution, Nitrogen, Odors, Carbon, Waste water treatment, Aeration, Aerobic treatment, Anaerobic digestion.
Identifiers: Pollution potential, Waste characteristics, Integrated farming, Aerobic composting.

This paper presents some of today's theories on waste treatment and their effectiveness, both socially and physically. The paper tells of the pollution potential and characteristics of animal waste, as well as some of the waste treatment objectives. Theoretical formulas are presented for the introduction of oxygen into an aqueous system, and the reduction of BOD. Potential solutions to the waste treatment problem are listed and summarized as follows: integrated farming, anaerobic holding, aerobic systems, complete treatment, anaerobic digestion, drying and incineration, and aerobic composting. Research needs are given, as well as a look to the future for what may be possible. (White-Iowa State)

0163 - D4

DESIGN PARAMETERS FOR THE STABILIZATION OF HIGHLY ORGANIC MANURE SLURRIES BY AERATION,
Rutgers - The State Univ., New Brunswick, N.J. Dept. of Environmental Sciences.
Albert F. Vickers, and Emil J. Genetelli.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 37-49. 7 fig, 6 tab, 11 ref.

Descriptors: *Farm wastes, *Poultry, *Aerobic treatment, *Biochemical oxygen demand, Dissolved oxygen odor, Waste water treatment.
Identifiers: Aerobic stabilization, Manure slurry, Ultimate disposal, Loading parameter, Suspended solids.

It has been determined in this research that aerobic stabilization basins are not suitable for the complete treatment of slurries of poultry manure. However, the aerobic stabilization basins do provide satisfactory pretreatment prior to ultimate disposal. This treatment provides sufficient stabilization of the manure to eliminate nuisance problems when ultimately disposed of on land. The critical loading parameter determined in this bench scale system is a volume loading of 60 cubic feet of aeration basin per pound of applied BOD in the manure slurry. The average BOD reduction in the unsettled effluent was 87% with an average solids destruction of 53%. Foaming difficulties were encountered after the critical loading parameter determined was exceeded. (White-Iowa State)

0164 - C1, D4

SWINE WASTES, CHARACTERIZATION AND ANAEROBIC DIGESTION,
Kansas Agricultural Experiment Station, Manhattan.
Lawrence A. Schmid, and Ralph I. Lipper.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 50-57. 4 tab, 2 fig, 3 ref.

Descriptors: *Farm wastes, *Anaerobic digestion, Swine, Biochemical oxygen demand, Chemical oxygen demand, Methane, Odor, Waste water treatment.
Identifiers: *Digester, Waste digestion, Feed ration.

Laboratory and field tests were undertaken to show the effectiveness of anaerobic digestion as a possible solution to swine waste treatment. The following conclusions are made from the study: (1) The waste characteristics can be related to pounds of waste per unit pound of live weight. (2) If organic removal is the desired objective, it can best be done by solids removal from the fresh wastes resulting in COD reductions of 90%. (3) Mixing is required in the anaerobic digestion phase to disperse the fresh waste. (4) Normally, the efficiency of anaerobic treatment can be increased by increasing the solids retention time. (5) Results have shown that conventional anaerobic digestion cannot be practiced on raw undiluted hog wastes which include the urine. (6) Digestion only for liquifaction does not require the close environmental control required to stimulate growth of methane bacteria. (7) Design for the objective of waste liquifaction for the purpose of reuse as flushing water, ultimate disposal on land, and ease of handling can be one answer to the problem of handling and treatment of wastes from confinement feeding of swine. (White-Iowa State)

0165 - B3, C5, D4

AEROBIC DECOMPOSITION OF SOLID WASTES FROM CATTLE FEEDLOTS,
Texas Technological Coll., Lubbock. Dept. of Civil Engineering.
D. M. Wells, R. C. Albin, W. Grub, and R. Z. Wheaton.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 58-62. 4 fig.
Descriptors: *Farm wastes, *Moisture content, Cattle, Temperature, Nitrogen, Phosphorus, Waste water treatment.
Identifiers: *Aerobic stabilization, *Composting process.

This is a progress report on research being conducted on the aerobic stabilization of solid beef feedlot wastes and is concerned with the composting process and with the effect of feed, management, and climate on waste stabilization. Two general areas were reported in the paper, one concerned with composting in open air piles and the other with composting in a specially built drum type digester. Forty per cent reductions in volume and 20% losses in dry matter were noted. The most rapid rate of stabilization seemingly takes place during the first few days of the process, with a steady decrease in the rate of stabilization occurring with time. (White-Iowa State)

0166 - C3, D4

ANALYSIS FOR OXYGEN TRANSFER COEFFICIENTS IN ROTOR AERATION SYSTEMS,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
John J. Kolega, Gordon L. Nelson, and Quintin B. Graves.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 63-75. 9 fig, 4 tab, 13 ref.

Descriptors: *Farm wastes, *Equations, Oxygen, Dissolved oxygen, Oxygenation, *Model studies, Waste water treatment.
Identifiers: *Rotor aerator, *Oxidation ditch, Oxygen transfer.

The laboratory method described presents a technique for use in the engineering design and analysis of a horizontal rotor aerator system in livestock waste management. This procedure can be used to obtain quantitative prediction equations to estimate the oxygen transfer coefficients for a selected range of operating conditions. Once the prediction equation for a given system is developed, it can be further used to evaluate new applications provided the parameters fall within the range of the predicted equation developed. An equation for estimating the oxygen transfer coefficients per revolution of rotor was obtained with a model rotor aerator using distilled water as the liquid. Rotor aerator performance curves illustrating how the prediction equation can be used in livestock waste system design and management were also developed. (White-Iowa State)

0167 - A5, C3, D4

AEROBIC STORAGE OF DAIRY CATTLE MANURE,
Purdue Univ., Lafayette, Ind. School of Civil Engineering.
Don E. Bloodgood, and C. M. Robson.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 76-80. 2 tab, 1 fig, 4 ref.

Descriptors: *Farm wastes, Cattle, Aeration, Temperature, Odor, Chemical oxygen demand, Waste water treatment.
Identifiers: Dairy cattle, Loading rates, Kjeldahl nitrogen, Degradation, Volatile solids.

Laboratory tests with seven liter, aerated containers were performed in 4C and 24C rooms. Loading rate of 60, 80, 100, and 120 grams of wet raw dairy manure per day were used at both temperatures. Conclusions were made from the results of the experiment as follows. (1) The amount of leading does not influence the degree of degradation that takes place. (2) The tests indicate a decrease in volatile solids of 20 per cent at 4C and

42 per cent at 24C. (3) Appreciable amounts of material with a COD are removed in the aerobic storage process. (4) The Kjeidahl nitrogen concentration of material remaining after aerobic storage is higher after the storage period. (5) Foaming is a real problem in the aerobic storage of manure from dairy cattle. (6) Aerobic storage of manure from dairy cattle has promise of minimizing the odor problem encountered in the spreading of unaerated material after storage. (White-Iowa State)

0168 - B2, C3, C4, D4, E3
AEROBIC DIGESTION OF DILUTED ANIMAL MANURE IN CLOSED SYSTEMS - TEMPORARY EXPEDIENT OR LONG RANGE SOLUTION,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
J. T. Clayton, and T. H. Feng.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 81-87. 6 fig, 1 ref.

Descriptors: *Farm wastes, *Aerobic treatment, *Anaerobic digestion, *Effluents, Cattle, Biochemical oxygen demand, Nitrates, Hydrogen ion concentration, Waste water treatment.
Identifiers: *Sedimentation tanks, *Degradation, Volatile solids.

The pilot scale manure treatment system studied was an adapted composite of two aerobic-anaerobic dairy manure treatment systems. It was designed to process the waste of one mature dairy cow, together with the water necessary to flush the manure from the barn. The system consisted of a 2000 gallon primary sedimentation tank, a 1000 gallon aeration tank, and a 200 gallon final sedimentation tank. The effluent was collected and analyzed at three different points in the closed system. Graphs of total solids, volatile solids, pH, BOD, and nitrate content versus time are given for the three effluent collection points. The overall objective was to design a system the effluent from which could be used as a flushing and transport medium for subsequent cleanings of a dairy cow housing facility, or be discharged into a water course. (White-Iowa State)

0169 - C3, D3
INFLUENCE OF CHEMICAL TREATMENTS UPON DIGESTIBILITY OF RUMINANT FECES,
Agricultural Research Service, Beltsville, Md. Animal Husbandry Research Div.
L. W. Smith, H. K. Goering, and C. H. Gordon.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 88-97. 10 tab, 11 ref.

Descriptors: *Farm wastes, *Cattle, *Digestion, Sheep, Orchardgrass, Alfalfa, Ruminants, Waste water treatment.
Identifiers: Sodium hydroxide, Sodium peroxide, In vitro fermentation, Chemical treatment.

Sodium hydroxide and sodium peroxide treatment of orchardgrass and alfalfa cow feces resulted in large decreases in the cell wall (CW), cellulose, hemicellulose, and lignin contents. Treatment with sodium chlorite changed composition little except for a large reduction in lignin content. True CW digestibility was increased several fold by each treatment as measured by an in vitro fermentation technique. Corn silage rations containing 25% of the total dry matter (DM) as either untreated or 3% sodium peroxide treated orchardgrass feces were consumed equally well as an all corn silage ration by sheep. Lower intake was observed for a corn silage ration which contained 50% similarly treated feces also on a dry matter basis. Digestibility coefficients for the various components of the feces portion of the rations were calculated by difference. Addition of 3% sodium peroxide to feces increased average DM, 29; nitrogen, 25; CW, 55; cellulose, 41; and hemicellulose, 90 digestibility units over that of the untreated feces. Neither concentration nor molar ratios of ruminal volatile fatty acids changed due to the inclusion of treated or untreated feces in rations for sheep. (White-Iowa State)

0170 - E3
THE VALUE OF HYDROLYZED AND DRIED POULTRY WASTE AS A FEED FOR RUMINANT ANIMALS,
Pennsylvania State Univ., University Park.
T. A. Long, J. W. Bratzler, and D. E. H. Frear.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 98-104. 12 tab.

Descriptors: *Farm wastes, *Feeds, *Nitrogen, Poultry, Cattle, Sheep, Waste water treatment.
Identifiers: *Hydrolyzed poultry waste, Rations, Feedlot performance, Digestion coefficient, Carcass characteristics.

Information was presented concerning the value of heat treated poultry waste as a source of nutrient for ruminant animals. In a metabolism trial, whethers were fed a semi-purified ration in which the nitrogen was supplied by hydrolized poultry waste, cooked poultry waste, or soybean oil meal. The digestion coefficients for crude protein differed significantly (PA.05) between all rations. Nitrogen excreted in the feces was significantly lower for the soybean oil meal ration than for the poultry waste ration. No other significant differences were observed. It was found in a fattening trial with steers that rate of gain, feed efficiency, and carcass grade were not significantly different for beef steers fed rations in which the supplemental nitrogen was supplied as soy bean oil meal, hydrolized poultry waste or dried poultry waste. Rate of gain was higher (PA.05) for the steers fed the ration containing urea. The treated poultry waste rations were readily consumed by the steers and no undesirable effect on carcass characteristics were found. (White-Iowa State)

0171 - E3
CATTLE MANURE: RE-USE THROUGH WASTELAGE FEEDING,
Alabama Agricultural Experiment Station, Auburn.
W. Brady Anthony.
In: Animal waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 105-113. 9 tab, 1 fig, 10 ref.

Descriptors: *Farm wastes, *Cattle, Feeds, Performances, Waste water treatment.
Identifiers: *Wastelage, Yeast fermentation.

Manure collected daily from a concrete floor of a pen housing steers was blended with a fattening feed in the ratio of 2:3. The wastelage system was developed for more flexibility. Wastelage is the combining of fresh manure with ground grass hay in the ratio of 57:43 with storage in a silo until fed. Five conclusions were drawn from the study. (a) Fresh feedlot manure can be mixed with concentrate and fed successfully to cattle with a considerable saving in feed used per unit of beef produced. (b) Wastelage represents a flexible system of removing manure daily, blending it with hay, and storing as silage. (c) Elimination of pollution from steer feedlots can be obtained through use of the wastelage plan. (d) Yeast can be produced on fluidized and aerated manure. About 68% of manure dry matter appears recoverable in the yeast fermentation product. (e) Feedlot manure properly handled is a valuable product for conversion to an animal feed. (White-Iowa State)

0172 - E2
SPECIFICATIONS FOR EQUIPMENT FOR LIQUID MANURE DISPOSAL BY THE PLOW-FURROW-COVER METHOD,
Rutgers - The State Univ., New Brnuswick, N.J. Dept. of Agricultural Engineering.
Charles H. Reed.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 114-119. 8 fig.

Descriptors: *Slurries, *Disposal, Farm wastes, Poultry, Waste water disposal.
Identifiers: *Plow-furrow-cover, Utilization.

A condensation is presented of experimental work that was done on land application of poultry manure slurries. Several pieces of equipment and different operations were looked at. Most incorporated a single bottom 16 in. plow operating 7 in. to 8 in. deep. Manure was deposited in the furrow and then covered. Tank trailers and commercial liquid manure tanks were used to transport and funnel the slurry into the furrow. General performance specifications for plow-furrow-cover equipment is included. (White-Iowa State)

0173 - C3, E3
USE OF POULTRY MANURE FOR CORRECTION OF Zn and Fe DEFICIENCIES IN PLANTS,
Colorado State Univ., Fort Collins. Dept. of Agronomy.
B. F. Miller, W. L. Lindsay, and A. A. Parso.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 120-123. 2 tab, 6 ref.

Descriptors: *Farm wastes, *Fertilizers, Poultry, Iron, *Corn, Waste water treatment.
Identifiers: *Micronutrient deficiency, Zinc.

A greenhouse study was conducted with corn on a soil deficient in available Zn and Fe. Fifteen fertilizer combinations including N,P, Zn, Fe, poultry manure and poultry manure ash were used. Adequate K was supplied by the soil. The results of this study are interpreted as showing that poultry manure is beneficial for the correction of Zn and Fe deficiencies. This benefit is supplementary to its value as an NPK fertilizer. Furthermore, the organic fraction of poultry manure is important in rendering Zn and Fe more available to plants. This beneficial effect is greater in the case of Fe than Zn, but it is significant in both cases. The findings of this study support the hypothesis that manure and other organic wastes may either supply or give rise to natural chelating agents that aid in the solubilization of insoluble micronutrient elements in soil and thereby render them more available to plants. (White-Iowa State)

0174 - A2, A4, C3, E2
THE NITROGEN PROBLEM IN THE LAND DISPOSAL OF LIQUID MANURE,
Guelph Univ. (Ontario). Dept. of Soil Science.
L. R. Webber, and T. H. Lane.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 124-130. 3 tab, 1 fig, 13 ref.

Descriptors: *Farm wastes, *Nitrogen, *Groundwater, Nitrates, Water pollution sources, Waste water treatment.
Identifiers: *Nitrogen pollution, Crop utilization, Pollution control.

Segments of research are presented that lead to the preparation of guidelines outlining the cropland requirements for the utilization and disposal of the nitrogenous compounds in liquid manures. The objective in land spreading was two-fold: (a) to apply the waste at such rates that the practice will be nitrogen utilization for crop production at optimum use-efficiency; and (b) to apply the waste at such rates that the practice becomes primarily one of disposal while not contributing to environmental pollution (air, water, soil). Tables show the different rates of application and how the nitrogen is removed. Recommendations are given as to how much land is required for crop utilization and pollution control for different livestock operations. (White-Iowa State)

0175 - D1

STATUS REPORT ON WATER POLLUTION CONTROL FACILITIES FOR FARM ANIMAL WASTES IN THE PROVINCE OF ONTARIO,
A. R. Townshend, K. A. Reichert, and J. H. Nodwell.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 131-149. 14 tab, 5 fig, 9 ref.

Descriptors: *Farm wastes, *Water pollution control, Cattle, Hogs, Poultry, Lagoons, Waste water treatment.
Identifiers: *Population equivalent, *Confinement housing, Pollution potential, Concentrations, Land disposal, Oxidation ditch.

Farm animal waste problems of the agricultural industry in Ontario are concentrated on the liquid manure water pollution control facilities presently serving swine, beef cattle, dairy cattle, and poultry confinement housing operations. It is concluded that based on present technology and economics, the approach to animal waste disposal in Ontario for the forseeable future should continue to be one of storage and land disposal rather than treatment and effluent discharge to water courses. The status report estimates the pollution potential of farm animal wastes; outlines the present methods of handling liquid manure from confinement operations; tabulates animal waste characteristics, loadings, and population equivalents; gives field data and experiences on typical water pollution control facilities; and concludes with guidelines on the selection, design, and operation of farm waste systems. (White-Iowa State)

0176 - D4, E2

DISPOSAL OF DAIRY CATTLE WASTES BY AERATED LAGOONS AND IRRIGATION,
Purdue Univ., Lafayette, Ind. Dept. of Agricultural Engineering.
A. C. Dale, J. R. Ogilvie, A. C. Chang, and M. P. Douglas.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 150-159. 11 fig.

Descriptors: *Farm wastes, *Oxidation lagoon, *Sprinkler irrigation, Biochemical oxygen demand, Chemical oxidation demand, Oxidation-reduction potential, Odor, Irrigation, Waste water treatment.
Identifiers: Dairy cattle.

The system studied the aerobic type using a lagoon for storage and treatment but relying solely on sunlight and algae for oxygen. A mechanical surface aerator was used to supply oxygen and for mixing. An overhead sprinkler irrigation system was used in conjunction with the treatment lagoon. The liquid was applied to cropland (grassland) beside the lagoon. Perameters measured included BOD, COD, total solids, volatile solids, pH, and total gallons of influent and effluent; temperature, DO, pH and oxidation-reduction potential of the mixed liquor; distribution of effluent by irrigation; and odor associated with the area. Tentative conclusions were reached as a result of work to date: (a) The system is odorless. (b) The system provides a place to dispose of wastes at all times. (c) Nutrients are saved and are returned to the land. (d) With proper operation, runoff into streams and ditches is minimized. (e) Pollutional characteristics of all wastes are greatly lowered. (f) Cost of installation and operation do not appear to be excessive. (g) A relatively small amount of labor is required. (White-Iowa State)

0177 - B2, D4

FIELD TESTS OF OXIDATION DITCHES IN CONFINEMENT SWINE BUILDINGS,
Illinois Univ., Urbana. Dept. of Agricultural Engineering.
Don D. Jones, Donald L. Day, and James G Converse.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 160-171. 15 fig, 1 ref.

Descriptors: *Farm wastes, *Hogs, *Rotors, Oxygen demand, Biochemical oxygen demand, Chemical oxygen demand, Waste water treatment.
Identifiers: *Oxidation ditch, *Confinement buildings, Total solids, Volatile solids.

Tests at the University of Illinois were conducted using two buildings with oxidation ditches. Detention time, rotor speed, rotor immersion, and loading rates were varied. Oxygen demand, solids, BOD and COD were measured periodically and plotted by a digital computer. Problems with foaming and ammonia odor were encountered, but solved by altering the liquid depth and rotor immersion. Apparently the velocity of the waste in the ditch seems to be the controlling factor in oxidation ditch operation. Adequate velocity and oxygenation occurred when the immersion of the aeration rotor into the waste was equal to approximately one-third of the liquid depth. A liquid volume of 200 to 250 cubic feet of ditch volume per foot of rotor length served to maintain a velocity that prevented solids from settling in the ditch. With sufficient gutter volume to give 50 days detention time, the aerobic digestion process can reduce the 5-day BOD of hog waste from approximately 35,000 mg/l to around 3000 mg/l. (White-Iowa State)

0178 - D4

STUDY OF THE USE OF THE OXIDATION DITCH TO STABILIZE BEEF ANIMAL MANURES IN COLD CLIMATE,
Minnesota Univ., Minneapolis.
J. A. Moore, R. E. Larson, and E. R. Allred.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 172-177. 3 fig.

Descriptors: *Farm wastes, *Climates, *Air temperature, Biochemical oxygen demand, Chemical oxygen demand, Cattle, Rotors, Stabilization, Waste water treatment.
Identifiers: *Oxidation ditch, *Slatted floor.

When loaded at the rate of one animal per 210 cu. ft. of liquid it appears that the oxidation ditch can be operated in cold weather. From results of this trial it can be projected that the oxidation ditch can successfully function to contain and provide minimal treatment to beef cattle wastes in cold climate with the pollutional threat stored until spring. At that time the liquid which is too polluted to be discharged to a waterway might be applied to a receptive soil media for further treatment. The results of a summer operation at a loading rate of one animal per 140 cu. ft. of liquid, indicate that the system achieved an 87% reduction of 5 day BOD. Additional treatment will be required however, because the BOD of the slurry was 22,000 mg/l at the end of the test period. Results indicate that the oxidation ditch system can be used to treat beef waste in climates which experience extended periods of sub-freezing temperatures, although digestion is minimal at these temperatures. Some foaming resulted but was not a limiting parameter. Normal operation has resulted in a low odor level. Sludge buildup was not a problem with an annual cleanout cycle. (White-Iowa State)

0179 - C3, D4

CHANGES IN COMPOSITION OF CONTINUOUSLY AERATED POULTRY MANURE WITH SPECIAL REFERENCE TO NITROGEN,
Guelph Univ. (Ontario).
J. B. Edwards, and J. B. Robinson.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 178-184. 5 fig, 2 tab, 8 ref.

Descriptors: *Farm wastes, *Nitrogen, Poultry, Aeration, Nitrification, Denitrification, Oxidation-reduction potential, Rotors, Waste water treatment.
Identifiers: *Nitrogen loss, *Oxidation ditch.

The objectives were (a) to study the nitrogen transformation in continuously aerated liquid manure, (b) to determine the most efficient means of eliminating nitrogen from waste (for situations in which sufficient land is not available to meet guidelines for pollution control) and (c) to determine what steps must be taken to prevent losses of nitrogen from liquid manure (for situations in which crop utilization is an integral part of the operation, and sufficient land is available). The study was limited to liquid poultry manure and this report deals, in a preliminary way, with changes in nitrogen components in such waste continuously aerated in both laboratory units and in an oxidation ditch. The results show that the mechanical rotor as operated was not capable of maintaining strictly aerobic conditions in the ditches for more than a few days. In spite of this, odor did not become a problem. From the limited data obtained, the oxidation ditch appears to be a useful device for controlling the ultimate nitrogen content of the manure before land utilization. By encouraging the nitrification-denitrification sequence nitrogen can be removed and, presumably, by inhibiting nitrification, nitrogen could be conserved. (White-Iowa State)

0180 - B2, D4

FARM WASTE DISPOSAL FIELD STUDIES UTILIZING A MODIFIED PASVEE OXIDATION DITCH, SETTLING TANK, LAGOON SYSTEM,
Farmland Industries, Inc.
Gerald R. Foree, and Richard A. O'Dell.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 185-192. 7 tab, 6 fig, 8 ref.

Descriptors: *Farm wastes, *Hogs, *Lagoons, *Efficiencies, Dissolved oxygen, Biochemical oxygen demand, Chemical oxygen demand, Hydrogen-ion concentration, Waste water treatment.
Identifiers: *Oxidation ditch, *Settling tank, Total solids, Fixed solids, Volatile solids.

The system studied was two buildings, capable of holding 10 sows and litters apiece, located over oxidation ditches. The ditches emptied into a settling tank which in turn emptied into a lagoon. Measurements of dissolved oxygen, temperature, pH, BOD, COD, various solids determinations, various nitrogen determinations, and bacterial quantitation were taken and presented in 7 tables and 5 graphs. The data indicated that the oxidation ditch itself operated at approximately 50% efficiency under optimum operating conditions. The total system ditch, settling tank and lagoon appeared to operate between 70 and 90 per cent efficiency, depending on the research parameter studied. (White-Iowa State)

0181 - F4

FEEDLOT POLLUTION CONTROL - A PROFILE FOR ACTION,
Federal Water Pollution Control Federation, Kansas City, Mo. Missouri Basin Region.
John M. Rademacher, and Anthony V. Resnik.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 193-202. 17 ref.

Descriptors: *Farm wastes, *Water pollution control, *Legislation, Groundwater, Water Quality Act.

Identifiers: *Feedlots, *Animal production, Research, Regulation.

This paper set the stage for the presentation of technical papers which followed at the Cornell University Animal Waste Management Conference. The background of animal production and examples of the pollution problem were given. Factors causing the problem of animal waste disposal were discussed as well as accomplishments to date. These accomplishments included Federal laws to control pollution. A profile for action was presented as a model for action. The essential elements were Re-education, Research and Regulation. He states that we have neither adequate knowledge for control nor full cooperation and involvement of all levels of Government and the private sector to solve the problems resulting from feedlot operations. More attention must be given to feedlot location and research devoted to the institutional problems of animal waste management. There must be an organized and coordinated, interdisciplinary approach to animal waste disposal. (White-Iowa State)

0182 - A2, C2, C3, C4

CATTLE FEEDLOT WATER QUALITY HYDROLOGY,
Colorado State Univ., Fort Collins. Dept. of Agricultural Engineering.
T. E. Norton, and R. W. Hansen.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 203-216. 2 tab, 14 fig, 14 ref.

Descriptors: *Farm wastes, *Cattle, *Hydrographs, *Water quality, Rainfall simulators, Rainfall intensity, Biochemical oxygen demand, Runoff, Alkalinity, Water pollution control, Waste water treatment.
Identifiers: *Feedlot runoff, *Hydrology characteristics, Surface storage, Effective depth, Overland flow.

The hydrologic and quality characteristics of runoff waste water resulting from precipitation on cattle feedlots are presented. The overall objective of the study was to determine if the hydrology characteristics could be correlated with the quality characteristics through a modification of the flat plate model of overland flow. Once this correlation was established, the results were used to predict the quantity and quality of the runoff from existing feedlots. The field equipment consisted of rainfall simulation equipment and a sample collection and control device. Runoff was collected and analyzed from a 28 sq. ft. plot in 18 separate runs on 13 different feedlots. The pollution characteristics of BOD, dissolved solids and alkalinity were correlated with an effective depth of overland flow. The correlation method and equations developed were used in an example of BOD prediction. (White-Iowa State)

0183 - A2, B1, C5

THE EFFECT OF FEED, DESIGN AND MANAGEMENT ON THE CONTROL OF POLLUTION FROM BEEF CATTLE FEEDLOTS,
Texas Technological Coll., Lubbock. Dept. of Agricultural Engineering.
W. Grub, R. C. Albin, D. M. Wells, and R. Z. Wheator.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 217-224. 5 fig, 2 tab.

Descriptors: *Farm wastes, *Cattle, *Runoff, Biochemical oxygen demand, Nitrogen, Phosphorus, Water pollution control.
Identifiers: *Feedlots, *Composition of wastes, Rations, Feedlot layout, Waste accumulation.

Incorporating both engineering and biological aspects, this report contains an analysis of data and suggests management and design practices that could materially reduce the pollution contributed from the small but densely populated feedlot area. The composition and quantity of wastes is looked at. The type of ration and changes in accumulated wastes are discussed in relation to the former topics. The effects of precipitation, surfacing material, land slope, depth of waste accumulation, feedlot layout, and ration composition are discussed with respect to composition and quantity of runoff. (White-Iowa State)

0184 - C3, C4, D4

TREATMENT OF WASTES FROM BEEF CATTLE FEEDLOTS - FIELD RESULTS,
Cornell Univ., Ithaca, N.Y.
Raymond C. Loehr.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 225-241. 8 fig, 4 ref.

Descriptors: *Farm wastes, *Cattle, *Anaerobic conditions, Alkalinity, Biochemical oxygen demand, Chemical oxygen demand, Ammonia, Nitrates, Nitrites, Rainfall, Water pollution, Digestion, Waste water treatment.
Identifiers: *Feedlots, *Aerobic stabilization, *Polishing unit, *Intermittent loading, Volatile acids, Volatile solids, Total solids, Turbine blower.

Results are presented from a field demonstration study to investigate an anaerobic-aerobic treatment system for beef cattle feedlot waste water, some of the management aspects of such a system are discussed, and data are presented on the quality of runoff from beef cattle feedlots. The demonstration system consisted of a 40,000 gallon anaerobic unit which overflowed into a 15,000 gallon aerobic unit. Aerobic stabilization was accomplished by means of a turbine blower and a simple diffuser system. The effluent from the aeration unit flowed to a polishing unit which provided for separation of the residual solids. The ability of this system to reduce the pollution from feedlot runoff was demonstrated. The system was able to absorb shock loads of waste that were periodically scraped into the anaerobic unit. The results of the study showed that frequent addition of wastes to the system, frequent mixing of the anaerobic unit, and removal of only a portion of the contents of the anaerobic unit materially assisted the satisfactory performance of the unit and the maintenance of equilibrium conditions. The individual units have been shown to function adequately with a minimum of attention. Further treatment would be required before the effluent could be released to a receiving stream. (White-Iowa State)

0185 - F4

WASTE DISPOSAL MANAGEMENT,
Cornell Univ., Ithaca, N.Y.
Charles E. Ostrander.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 242-244.

Descriptors: *Farm wastes, Nitrogen, Mortality, Water pollution effects, Incineration, Storage, Odor, Disposal, Water pollution sources.
Identifiers: Compost, Nuisance, Pollution hazard, Residential areas, Neighbors.

The immediate concern of the author was the improvement and the prevention of further destruction of our environment. He spoke of the magnitude of the agricultural waste problem indicating the greatness of the technological and economic aspects. The importance of animal waste as a source of organic nitrogen was pointed out, as were the dangers of inorganic nitrogen. Methods of handling and storage were brought out. The problem of disposing of mortality cases and possible solutions was discussed. Stress was placed on the creation of a favorable image of agriculture in the eyes of the public. (White-Iowa State)

0186 - D2, E3, F1

MANURE CONSERVATION,
HUPSI Corp., Wabash, Ind.
Robert M. LaSalle, Jr., and Mark Launder.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 245-248. 1 fig.

Descriptors: *Farm wastes, *Fertilizers, Poultry, Potash, Air-conditioning, Gross profit, Costs, Dehydration, Waste water treatment.
Identifiers: *Phosphoric acid, Anhydrous ammonia, *Manure conservation.

Tests were conducted in the fall and winter of 1967 on a proposed system of manure conservation. Poultry manure was stabilized and used as a fertilizer rather than going through a bio-degradation process. Troughs were placed under the chickens and a weak phosphoric acid solution flowed by gravity under subsequently lower cage levels and finally into a sump from which it was pumped to the upper most levels. Droppings were immediately stabilized, denatured, and deodorized upon falling into the solution. Additional treatment consists of buffering to reduce the acidity to the proper value for fertilizer and adding potash to increase the potash values to that commensurate with the nitrogen and phosphate analysis for commercial use. Buffering can be done with anhydrous ammonia or potash so that either the nitrogen or potash values are augmented. By these means control is available to bring the final product to any desired fertilizer analysis. An analysis of 10-3-2 can command a price of $61.60 per ton with a gross profit of $14.50 if dehydration is used. By refrigerating the solution flowing under the chickens, the chicken house is completely and perfectly air conditioned. (White-Iowa State)

0187 - A5, B2, D4

CAGED LAYER PERFORMANCE IN PENS WITH OXIDATION DITCHES AND LIQUID MANURE STORAGE TANKS,
Guelph Univ., (Ontario). Dept. of Poultry Science.
J. P. Walker, and J. Pos.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 249-253. 3 fig, 1 tab, 4 ref.

Descriptors: *Farm wastes, *Poultry, *Performance, Anaerobic conditions, Aerobic conditions, Mortality, Odor, Biochemical oxygen demand, Waste water treatment.
Identifiers: *Oxidation ditch, Feed conversion, Aerator, Population equivalent, Egg production.

The hen housed egg production, feed conversion and mortality performance of caged layers in a pen with oxidation ditches was slightly better than that of caged layers in pens with liquid manure, storage tanks. The odor in the pens with oxidation ditches was less offensive than in the pens with anaerobic storage. Aerators, however, should be installed outside the pen area. The tank design is very important from the standpoint of liquid circulation, and clean-out. A drain to a sump hole for cleaning is essential. The foaming problem, while controlled by commercial anti-foaming agents, limits the practical application of aerators for poultry until a more economical means is found. Cage systems that do not need dropping boards (eg. full stair-steps) should be used; this would eliminate shock loading, reduce odors and labor requirements. (White-Iowa State)

0188 - A6, B1, D1

PROBLEMS AND PRACTICES IN SOME SYSTEMS OF MANURE HANDLING IN

NORTHERN EUROPE,
Cornell Univ., Ithaca, N.Y. Dept. of Animal Science.
A. M. Meek, W. G. Merrill, and R. A. Pierce.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 254-259. 4 fig, 6 ref.

Descriptors: *Farm wastes, *Cattle, *Storage, Odor, Disposal, Waste water treatment.
Identifiers: *Dairy cattle, *Handling system, Slatted floors, Poisonous gases, Agitation, Free-stall housing.

Dairy manure handling systems and operations were visited in Scotland, England, Denmark and Sweden. The various types of systems consisted of under-building and outside-underground storage facilities with some type of pump or shuttle agitation system. Many incorporated steel or concrete slatted floors with manure storage pits underneath. Problems of odor and poisonous gases were discussed. A list of 15 safety points for the prevention of gas problems was given. Symptoms of gas poisoning were also listed. (White-Iowa State)

0189 - A5, C3

MEASUREMENT OF THE ODOR STRENGTH OF ANIMAL MANURES,
Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
A. T. Sobel.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 260-270. 6 fig, 4 tab, 10 ref.

Descriptors: *Farm wastes, *Odor, Poultry, Anaerobic conditions, Pollutant identification, Waste water treatment.
Identifiers: *Vapor dilution, *Threshold Odor Number, *Odor Intensity Index, Liquid dilution, Panel, Batch condition, Odor strength, Ranking.

Strength is a characteristic of an odor that can be measured. In contrast to characteristics such as quality and occurrence which rely only on individual opinion, strength allows associating a number with an odor. This can be very valuable for comparing manure handling systems as to odor production. Measurement of odor strength is usually accomplished by determining the magnitude of dilution required so that the odor is just detectable (olfactory threshold). The human nose is utilized as the detector. The application of the measurement of odor strength to animal manures was attempted in the laboratory. The method of liquid dilution and the method of vapor dilution were investigated. Vapor dilution looks at the odors arising from the manure while liquid dilution is concerned with the odors in the manure or the odor potential of the manure. Fifteen conclusions and observations were made as a result of the study. (White-Iowa State)

0190 - A5, B1, C3, C4

MICROBIOLOGICAL AND CHEMICAL CHANGES IN POULTRY MANURE ASSOCIATED WITH DECOMPOSITION AND ODOR GENERATION,
Cornell Univ., Ithaca, N.Y. Dept. of Food Science.
William E. Burnett, and Norman C. Dondero.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 271-291. 18 fig, 1 tab, 53 ref.

Descriptors: *Farm wastes, *Poultry, *Odor, Aerobic bacteria, Anaerobic bacteria, Ammonia, Hydrogen sulfide, Sulfur bacteria, Waste water treatment.
Identifiers: *Olfactory threshold test, *Odor Intensity Index, *Threshold odor numbers, Uric acid, Odor panel, Volatile organic acids.

Changes in the microbial and chemical composition of batch lots of 'dry' and 'liquid' poultry manure during decomposition were related to the production of offensive odors. The decomposition of uric acid by both aerobic and anaerobic uricolytic bacteria appeared to be related to the formation of significant quantities of ammonia. The number of sulfate-reducing bacteria, including Desulfovibrio species, increased during the course of decomposition of liquid poultry manure. These organisms were implicated as producers of some of the hydrogen sulfide in liquid poultry waste. There were apparent correlations between an increase in odor intensity of liquid manure with increased storage time and the concentrations of volatile organic acids, ammonia, and sulfides. (Miner-Iowa State)

0191 - A5, D3

CHEMICAL ASPECTS OF ODOR REMOVAL IN SOIL SYSTEMS,
Washington Univ., Seattle. Dept. of Civil Engineering.
R. C. Gumerman, and D. A. Carlson.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 292-302. 6 fig, 1 tab, 7 ref.

Descriptors: *Farm wastes, *Odor, *Hydrogen sulfide, Soil moisture, Waste water treatment.
Identifiers: *Soil filter, *Removal mechanism, Detention time, Reaction temperature.

On the basis of the data presented, it was found possible to postulate mechanisms which describe the removal of hydrogen sulfide species on soil in both wet and dry conditions. Removal of high concentrations of hydrogen sulfide from moving air streams is performed much more efficiently by dry soil than wet. Inter-related parameters which influence the removal of hydrogen sulfide by dry sterile soil are detention time, reaction temperature, amount of hydrogen sulfide entering, concentration of hydrogen sulfide, and the total flow rate. A method of design optimization is presented which determines for a given concentration and influent gas temperature, the total flow rate at which the maximum removal of hydrogen sulfide per unit time results. It is felt this design optimization method should be restricted to air streams containing only hydrogen sulfide, until further research delineates the removal mechanism for other odorous gases. (White-Iowa State)

0192 - A5, A6, D2

POULTRY HOUSE DUST, ODOR AND THEIR MECHANICAL REMOVAL,
Harry J. Eby, and G. B. Willson.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 303-309. 1 tab, 5 fig, 6 ref.

Descriptors: *Farm wastes, *Poultry, *Odor, *Dusts, Filters, Waste treatment.
Identifiers: Foam pad filters, Clogging.

Tests of plastic foam pad filters as a method of trapping the odor carrying dusts from a poultry house exhaust fan air stream have shown that foam pads of 10 to 40 pores per square inch are effective. However, the tests show that such pads become clogged with dust in about 6 to 9 hours of operation. Vacuum cleaning and water washing methods of cleaning for continued use were ineffective and the high initial cost of the foam filter material were deemed to make this method impractical. Tests of a device in which the exhaust air is deflected tangentially across a 1/2 inch mesh screen showed that such methods would remove at least a portion of the odor carrying dust. These were also deemed impractical in that the filter ability would appear to be a direct function of the relative humidity and as such would be the least efficient when low relative humidity within the poultry house would make the dust problem the greatest. Other methods of possible filtering techniques were discussed. (White-Iowa State)

0193 - A3, C2, C3, C4, D4

CHARACTERISTICS OF AQUEOUS SOLUTIONS OF CATTLE MANURE,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
John C. Ward, and E. M. Jex.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 310-326. 5 fig, 4 tab, 25 ref.

Descriptors: *Farm wastes, *Cattle, *Aqueous solutions, Biochemical oxygen demand, Dissolved solids, Hydrogen ion concentration, Foaming, Oxidation-reduction potential, Coagulation, Waste water treatment.
Identifiers: *Volatile solids, *Colloidal properties, Activation energy.

The primary objective was to investigate the aqueous characteristics (biochemical oxygen demand, conductivity, pH, oxidation-reduction potential, coagulation and colloidal properties, dissolved solids, volatile solids, and foaming) of solutions of cattle manure containing the combined urine and feces present in samples from cattle feedlots. This information could then be used in the design of facilities for treating runoff from cattle feedlots. It was assumed that treatment of this runoff would probably be by means of lagoons used to capture the runoff, and that these lagoons would be artificially aerated. In this type of aerobic treatment, the biochemical oxygen demand is satisfied in much the same way as in a stream. Formulas were developed and explained and 25 references were utilized. (White-Iowa State)

0194 - C4

TYPICAL VARIATIONS ENCOUNTERED IN THE MEASUREMENT OF OXYGEN DEMAND OF ANIMAL WASTES,
Ohio State Univ., Columbus. Dept. of Agricultural Engineering.
E. Paul Taiganides, and Richard K. White.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 327-335. 2 tab, 7 fig, 9 ref.

Descriptors: *Farm wastes, *Biochemical oxygen demand, *Oxygen demand, Temperature, Hogs, Cattle, Poultry, Sheep, Pollutant identification, Waste water treatment.
Identifiers: *Warburg, *Sewage Seeding, *BOD oxygen probe, Dilution effects.

Tables and figures were presented to emphasize the inherent variability in the parameters used in measuring oxygen demand. Reliable values of oxygen demand are essential because they are used as design parameters in waste treatment plants. Past and present experiments are being done with large numbers of replicates for each experiment to determine a reliable range of values for the various oxygen demand parameters of animal wastes. BOD was expressed in milligrams of oxygen required per gram of total solid matter (mg O2/g TS) since values reported in ppm or mg/l are useless because of the large variability in solid content of the waste and the high dilutions needed for the BOD test. Three methods of determining the BOD of animal waste were tested. These were the standard test, the BOD oxygen probe and Warburg. Effects of temperature and seeding with sewage were also explored. (White-Iowa State)

0195 - C5, D4

ROLE OF EXCRETED ANTIBIOTIC IN MODIFYING MICROBIAL DECOMPOSITION OF FEEDLOT WASTE

Colorado State Univ., Fort Collins. Dept. of Microbiology.
S. M. Morrison, D. W. Grant, Sister M. P. Nevins, and Keith Elmund.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 336-339. 1 tab, 2 ref.

Descriptors: *Farm wastes, *Antibiotics, Cultures, Cattle, Confinement pens, Biodegradation, Pesticide residues, Assay, Water pollution sources.
Identifiers: *Chlortetracycline, *Biological stabilization, Feedlot, Manure decomposition, Microbial decomposition, In situ manure.

The results presented in this paper are derived from studies on the process of biological stabilization of feedlot manure and the acceleration of the stabilization process. It is a specific study on some microbial inhibitions which may be playing a role in the biodegradation of feedlot waste. Samples of manure were taken from pasture, in situ manure from feedlot pens, and stockpiled manure from a feedlot. Cultures of the filter-sterilized manure extract gave rather conclusive evidence that the substance causing growth inhibition in the extracts was chlortetracycline residue in the excreted manure. It was calculated that 75% of the ingested antibiotic was excreted in the feces. Temperature tests indicate that during the winter months biodegradation of manure is not only inhibited by cold temperatures but also by the persistence of the antibiotic residue and the continuous deposition of antibiotic containing fresh manure. (White-Iowa State)

0196 - C3, E3

THE INFLUENCE OF VARIOUS FACTORS ON POULTRY LITTER COMPOSITION,
Pennsylvania State Univ., University Park. Dept. of Animal Science.
F. F. El-Sabban, T. A. Long, R. F. Gentry, and D. E. H. Frear.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, 1969, p 340-346. 4 tab, 18 ref.

Descriptors: *Farm wastes, *Poultry, Nitrogen, Carbohydrates, Insulation, Ventilation, Mineralogy, Moisture, Correlation analysis, Nutrients, Waste water treatment.
Identifiers: *Litter composition, *Nutritive value, Dry matter, Crude protein, True protein, Ether extract, Crude fiber.

A study was conducted to determine the chemical composition of poultry waste (litter and manure), relevant to its possible utilization as a source of nutrients. Litter samples were obtained from 33 broiler houses and 22 laying houses. Fresh manure was secured from 5 houses having layers in cages. The dry matter content was determined and samples were analyzed for crude protein, true protein, crude fiber, ether extract, and total ash. In addition, twelve mineral elements were determined. Poultry litter was found to contain considerable amounts of nutrients, particularly nitrogen and carbohydrates. Various factors such as bird type, bird density, kind of litter base material, litter depth, and poultry house conditions (ventilation, insulation, and house temperature) were all found to affect the proximate components of poultry litter. If poultry waste is to be utilized for its nutritive value for plants or animals, it is recommended that each batch be chemically analyzed before use. Although a limited number of samples was available, variation in composition was sufficient to warrant their individual analysis. (White-Iowa State)

0197 - D2

REMOVAL OF WATER FROM ANIMAL MANURES,
Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
A. T. Sobel.
Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, p 347-362, 1969. 8 fig, 2 tab, 12 ref.

Descriptors: *Farm wastes, *Poultry, *Moisture content, Odor, Weight, Volume, Humidity, Waste water treatment.
Identifiers: *Equilibrium moisture content, *Relative humidity, Handling characteristics, Volatile solids, Drying times, Thermal removal.

The removal of water from animal manures changes the handling characteristics of the manure, reduces the weight and volume to be handled, and reduces the offensive odor of the manure. Water can be removed from manure by mechanical, thermal, and absorptive means. Mechanical methods such as direct pressing present the difficulty of the removed water containing considerable volatile solids. Thermal removal was investigated from the standpoint of utilizing a thin layer, unheated air, and very low or 'static' air velocity. The equilibrium moisture content of chicken manure is comparable with other agricultural hygroscopic materials. Equilibrium moisture content values are presented for temperatures 70, 90, 110F. Drying times for chicken manure under these conditions is in terms of days. Drying times are greatly influenced by sample variation. Effects of humidity on drying time are significant but sample variation has an effect similar to a plus or minus 15% relative humidity change. Moisture loss from a 'deep' layer of manure is less than that from a free water surface. (White-Iowa State)

0198 - F4

LIVESTOCK PRODUCTION VS. ENVIRONMENTAL QUALITY - AN IMPASSE,
Economic Research Service, Washington, D.C. Natural Resource Economics Div.
Joseph P. Biniek.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, p 363-368, 1969. 14 ref.

Descriptors: *Farm wastes, *Economic efficiency, Water Quality Act, Air pollution, Odors, Water pollution control.
Identifiers: *Livestock production, *Production efficiency, *Environmental quality, Quality standards, Public conern, Economic development.

The possibilities of merging the two objectives of production efficiency and environmental quality are explored. To establish a basis for merging the two objectives, the author discusses environmental quality, quality standards, and public concern. Secondly he reviews the changing concepts of economic efficiency and illustrates these changes by discussing four stages of economic development. The discussion is concluded with a section devoted to the merging of the two objectives, environmental quality and production efficiency. An impasses can be averted, but it will require new modes of thought, and constructive responses to new situations. (White-Iowa State)

0199 - A1, B1, D2, D4, F1

RELATIVE ECONOMICS OF ANIMAL WASTE DISPOSAL BY SELECTED WET AND DRY TECHNIQUES,
Resource Engineering Associates, Inc., Stamford, Conn.
Robert W. Okey, Robert N. Rickles, and Robert B. Taylor.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, p 369-387, 1969. 5 fig, 17 tab, 11 ref.

Descriptors: *Farm wastes, *Cattle, *Cost analysis, Effluent, Biochemical oxygen demand, Chemical oxygen demand, Odor, Aeration, Nitrogen, Denitrification, Ultimate disposal, Incineration, Waste water treatment.
Identifiers: Wet systems, Dry systems, Effluent standards, Clarifier systems, Biological conversion, Solids conditioning system, Scrubbing system, Ancillary system.

The report presents the basic elements required for the design of two waste treatment facilities to handle the wastes from feedlots carrying 500, 1000, 5,000, 10,000, and 25,000 animals. The plants were designed to meet specified liquid and gaseous effluent standards. The standards selected are believed to be consistent with present and projected effluent requirements. It should be noted that some water courses may not be able to assimilate effluents of the quality discussed here. The two systems designed and costed in this work employed on one hand more or less conventional liquid waste treatment procedures; the other employed incineration and treated the undiluted animal waste as delivered as a solid waste, i.e., sludge. The capital and operational cost of these systems were computed and related to the number of animals and the gain anticipated in the feedlot. A waste treatment cost in terms of animal-years and per pound was then obtained. Five conclusions were reached as a result of the study, among them, that wet systems are more expensive to own and operate than systems designed to handle solids. (White-Iowa State)

0200 - E2, E3, F1

THE ECONOMICS OF POULTRY MANURE DISPOSAL,
New York State Coll. of Agriculture, Ithaca.
R. E. Linton.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, p 388-392, 1969.

Descriptors: *Farm wastes, *Poultry, *Economics, *Land use, Fertilizers, Nitrogen, Phosphorus, Potash, New York, Disposal, Waste water treatment.
Identifiers: *Land disposal, *Cost calculations, *Waste management, Transportation costs, Catskill resort industry.

This study was initiated in response to the general problem of conflicts over rural land use, particularly those involving farm operations. More specifically and as a notable example, the study dealt with the problems of conflict between poultry and other land uses. The problem of land use conflict related to waste management was approached through the aspect of recognizing the internal costs to farmers of some of the alternatives in waste management. As a result of the study one particular pattern of manure disposal seemed to justify serious consideration and was singled out for discussion and cost calculations. This pattern included some means of land spreading as a practical and acceptable disposal method. Comments were made about the value of poultry manure in replacing commercial fertilizer, and this value is discussed as a means of at least partial disposal cost recovery. (White-Iowa State)

0201 - E2, F1

ECONOMIC RETURN FROM VARIOUS LAND DISPOSAL SYSTEMS FOR DAIRY CATTLE MANURE,
Cornell Univ., Ithaca, N.Y.
L. W. McEachron, P. J. Zwerman, C. D. Kearl, and R. B. Musgrave.
Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, p 393-400, 1969. 11 tab, 13 ref.

Descriptors: *Farm wastes, *Fertilizers, *Rotations, Cattle, Economics, Soil types, Disposal, Waste water treatment.
Identifiers: *Dairy cattle, Land disposal, Continuous corn, Lima silt loam, Manure hauling and spreading, Total digestible nutrients.

Census of Agriculture data are presented to indicate that dairy cattle manure could well be disposed of on the land. Farm cost accounting data are presented to indicate that cost per ton of hauling and spreading averaged $1.92 for farms with free stalls and about 140 cows to $3.18 for those with stanchions and 65 cows. Percent yield increase on crops grown per ton of manure applied range from .4% for oats to 6.6% for alfalfa. These percent yield increases were generalized without regard to mineral fertilization and applied to Warren's (1968) yield data for the state of New York at various farming levels. Without a charge for hauling and spreading dairy cattle manure crop yield returns ranged from $1.42 per tone to a deficit of $0.26. (White-Iowa State)

0202 - A5, B2, F1

ECONOMIC EVALUATION OF LIQUID MANURE SYSTEMS FOR FREE STALL DAIRY BARNS,

Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Economics.
George L. Casler.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, p 401-406, 1969. 3 tab.

Descriptors: *Farm wastes, *Economics, *Value, Cattle, Costs, Odor, Fertilizer, New York, Waste water treatment.
Identifiers: *Liquid manure system, *Labor distribution, *Labor requirements, Dairy cattle, Free stall barns.

The purpose was to evaluate liquid manure systems in free-stall dairy barns primarily from an economic viewpoint. If a liquid manure system is to be justified, such justification will have to be based on other advantages in addition to increased manure value and reduced labor requirement. The primary other advantage is the possibility of not hauling manure at periods of peak labor demand for planting and harvesting crops. However, to actually reap the benefits of improved labor distribution, a dairyman needs a reasonably long storage period and must very carefully plan his cleaning schedule. In addition, the very unpleasant odor created at the time the storage tank is emptied precludes the use of a liquid manure system in areas where neighbors would object to this odor. It appears to the author that the air pollution or odor problem is much more serious with a liquid manure system than with daily spreading. (White-Iowa State)

0203 - F2, F3

WHO SHOULD REGULATE POULTRY CONFLICT PROBLEMS,

Cornell University, Ithaca, N.Y. Coll. of Agriculture.
David J. Allee, and Pierre Clavel.
In: Animal Waste Management, Proceedings Cornell University Conference on Agricultural Waste Management, p 407-414, 1969. 5 ref.

Descriptors: *Farm wastes, *Poultry, *Technology, Local governments, State government, Odor, Communication, Waste water treatment.
Identifiers: *Regulatory mechanisms, Industry committee, Political resources, Waste management technology, Conflict, Resolution of problems.

Economic and social theory applicable to conflict situations, such as those that arise downstream or downwind from poultry houses, has some ability to indicate directions for administered solutions to these problems. Based upon such theory, related research and a case study of a number of ways in which rural communities have dealt with situations of stress between components of the community, the outlook for regulatory devices is appraised. An informal voluntary industry committee approach is found to be as effective in bringing together necessary technical expertise and social regulatory mechanisms as any other approach which the limited resources of many rural communities can support. It is suggested that because of a shortage of administrative and political resources many rural areas will resist effective resolution of conflict problems due to agricultural wastes until finally controls will be imposed by essentially urban oriented units of government. (White-Iowa State)

0204 - F4

POULTRY POLLUTION: PROBLEMS AND SOLUTIONS.

Michigan Agricultural Experiment Station, East Lansing.

Research Report 117, Farm Science, July 1970. 55 pages.

Descriptors: *Farm wastes, *Poultry, *Dehydration, Eggs, Nitrogen, Diets, Feeds, Odor, Water pollution, Air pollution, Soil contamination, Disease, Insects, Standards, Land use, Septic tanks, Sludge disposal, Digestion, Ventilation, Rates of application, Corn, Nitrate, Chemical properties, Drying, Moisture content, Nutrients, Taste.
Identifiers: Environmental quality, Indoor lagoons, Laying hens, Feed conversion, Egg production, Dehydrated poultry waste, Feed efficiency.

The report contains eleven articles with an introduction and a table compilation of properties of poultry waste that were analyzed. Reports on indoor septic handling of poultry manure and effect of application rate of chicken manure on corn yields are presented. A large part of the report deals with drying and feeding poultry manure to laying hens. Results of feeding dehydrated poultry waste to laying hens and its effect on egg production, feed conversion, body weight, egg weight, shell thickness, Haugh score, egg taste, and quality changes during storage are presented. Acceptability and digestibility of poultry and dairy wastes by sheep is also reported. Bacteriological procedures and current research being carried out at Michigan State University conclude the report. (White-Iowa State)

0205 - F4

INTRODUCTION,

Michigan State Univ., East Lansing. Dept. of Poultry Science.
H. C. Zindel, and C. J. Flegal.
In: Research Report 117, Farm Science, MSU Agricultural Experiment Station, July 1970, p 4-7.

Descriptors: *Farm wastes, *Poultry, Odor, Water pollution, Air pollution, Soil contamination, Technology, Nitrates, Nitrites, Disease, Insects, Treatment, Disposal, Standards, Land use.
Identifiers: *Environmental quality, *Confinement production, Animal management, Facility design.

The introductory remarks explain that agriculture-related pollution is but one part of a large national problem; so it must be considered together with municipal, industrial, marine and all other types of pollution in developing an integrated plan for improving the quality of our environment. The volume of livestock wastes produced is a function of the degree concentration and the size of individual production units. Animal wastes are of concern in water, air, and soil pollution. Examples of the increasing numbers of livestock and poultry being produced are given. New and improved technology is needed to handle the wastes from these animals. Problems discussed concerning pollution are: disease, odor, soil contamination, and insects. Four areas of emphasis are given that encompass the elements of a program for controlling animal wastes. (See also W71-03555) (White-Iowa State)

0206 - A5, B2, D4

POULTRY MANURE HANDLING BY INDOOR SEPTIC TANKS (SO-CALLED 'INDOOR LAGOONS'),

Michigan State Univ., East Lansing. Dept. of Poultry Science.
J. A. Davidson, and C. J. Mackson.
In: Research Report 117, Farm Science, MSU Agricultural Experiment Station, July 1970, p 8-9.

Descriptors: *Farm wastes, *Poultry, *Septic tanks, *Sludge, Sludge disposal, Digestion, Odor, Ventilation.
Identifiers: *Indoor lagoons, Laying hens, Compressed air agitation, Paddle wheel agitation, Floor space.

The report details the use of shallow water filled tanks for the disposal of poultry manure. The experiment was carried on for 5 years, during which time several variations were used. The original experiment consisted of a tank 10' x 24' x 2' deep in a pen 20' x 24'. The tank was filled with 18" of water and all droppings were caught in the tank. The second year, compressed air was used to agitate the material. Approximately 9 inches of sludge was cleaned out after 11 months of operation. Flies were no problem. Successive experiments used different amounts and methods of agitation. Each year the sludge accumulation was cleaned out with a septic tank service truck. Indoor septic tanks (indoor lagoons) covering 1/2 the floor space can handle the droppings from 300 laying hens for at least 11 months. This means one annual cleaning. This method could be used in cage operations. (White-Iowa State)

0207 - E3

THE EFFECT OF APPLICATION RATE OF CHICKEN MANURE ON THE YIELD OF CORN,

Michigan State Univ., East Lansing. Dept. of Poultry Science.
L. S. Robertson, and John Wolford.
In: Research Report 117, Farm Science, MSU Agricultural Experiment Station, July 1970, p 10-15. 4 tab.

Descriptors: *Farm wastes, *Poultry, *Chemical properties, *Rates of application, Hydrogen ion concentration, Phosphorus, Potassium, Soil tests, Corn, Crop production, Michigan, Nitrate, Magnesium, Carbon.
Identifiers: *Plant food content, Huron County Michigan.

The report begins by giving an indication of the magnitude of the poultry manure problem in Michigan. Tables showing the chemical characteristics and plant food content of chicken manure are presented. The effect of high rates of manure application upon soil test results are shown. The application of 46.4 tons/acre of manure significantly increased the levels of phosphorus, potassium, magnesium, nitrate, and percent of carbon in the soil. At the same time, the pH level was reduced from 7.7 to 7.1. An experiment involving different rates of poultry manure application, one fertilizer application, and no treatment was used to determine the effect of chicken manure on corn grain yield. The use of commercial fertilizer did not increase corn yields. Previous field management made this result expected. The use of several rates of manure has not greatly affected the yields. The use of 46.4 tons/acre tended to decrease corn yields slightly. It is not known at the present time whether this apparent depression is real. The data suggest that a tremendous quantity of chicken manure can be incorporated into the soil without any opportunity for damage to a corn crop. (White-Iowa State)

0208 - D2

DRYING ANIMAL WASTE,

Michigan State Univ., East Lansing. Dept. of Agricultural Engineering.
T. C. Surbrook, J. S. Boyd, and H. C. Zindel.
In: Research Report 117, Farm Science, MSU Agricultural Experiment Station, East Lansing. July 1970, p 16-20. 5 tab, 1 fig.

Descriptors: *Farm wastes, *Poultry, *Cattle, *Hogs, *Drying, Moisture content, Nutrients, Bulk density, Costs, Screens, Electric power.
Identifiers: *Dryer operation, Hammermill, Drying chamber, Fuel consumption.

The report gives details and test results from a machine used for drying animal waste. Production figures for the drier while processing different kinds of animal excreta are given. Details of the drier operation are described. Initial moisture contents ranged from 72 to 82 percent. The machine incorporates inclined shaking surfaces and screens, a hammermill and temperatures from 200 to 1100F. The drier successfully processed dairy, beef, swine and poultry excreta. Costs to produce one ton of the dried product are given. A table gives projected numbers of animals which the machine might serve. Density and nutrient levels of the dried excreta are listed. Odors were less intense than that of fresh excreta. (White-Iowa State)

0209 - E3

THE UTILIZATION OF POULTRY WASTE AS A FEEDSTUFF FOR GROWING CHICKS,

Michigan State Univ., East Lansing. Dept. of Poultry Science.
C. J. Flegal, and H. C. Zindel.
In: Research Report 117, Farm Science, MSU Agricultural Experiment Station, July 1970, p 21-28. 5 tab, 21 ref.

Descriptors: *Farm wastes, *Poultry, *Dehydration, Amino acids, Analysis, Chemical properties, Diets, Nutrients, Bacteria, Feeds, Efficiencies, Weight, Mortality.
Identifiers: *Feed composition, Dehydrated poultry waste, Significance, Feed efficiency.

Two experiments were conducted to determine the nutritional value of dehydrated poultry waste (DPW) for growing chicks from 1 to 28 days of age. The four-week mean body weight of Leghorn-type chicks was not influenced when up to 20 percent of the diet consisted of the DPW. Diets which contained levels of 10 and 20 percent DPW, when fed to broiler-type chicks, resulted in a reduction in four-week mean body weight; 5 percent DPW had no influence on the four-week mean body weight. Food efficiency was inversely related to the level of DPW in the diet; i.e., the higher the level of DPW, the poorer the feed efficiency. However, in the trial in which broiler-type chicks were used, added fat placed in the diet which contained 20 percent DPW improved weight gain and feed efficiency. It is suggested that the DPW used in these trials was a low energy product. (White-Iowa State)

0210 - E3

THE RESULT OF FEEDING DRIED POULTRY WASTE TO LAYING HENS ON EGG PRODUCTION AND FEED CONVERSION,

Michigan State Univ., East Lansing. Dept. of Poultry Science.
C. J. Flegal, and H. C. Zindel.
In: Research Report 117, Farm Science, MSU Agricultural Experiment Station, July 1970, p 29-30. 2 tab.

Descriptors: *Farm wastes, *Poultry, Eggs, Feeds, Diets, Corn, Lipids, Calcium, Phosphorus.
Identifiers: *Egg production, *Feed conversion, Dried poultry waste, White Leghorn layers.

Four replicates of eight birds each were fed one of thirteen possible diets which were presented in tabular form. The 416 White Leghorn type layers were on test for 139 consecutive days. Each hen was confined in an individual cage having a floor area of 8 x 16 inches. The percent egg production on a hen housed basis and kilos of feed per dozen eggs produced are also presented in tabular form. These data are presently being statistically analyzed to determine the differences, if any, between the various treatments. It appears that hens receiving control rations containing 10, 20, and 30 percent dried poultry waste have respectively lower production and higher feed requirements per dozen eggs. (White-Iowa State)

0211 - E3

THE EFFECT OF FEEDING DEHYDRATED POULTRY WASTE ON PRODUCTION, FEED EFFICIENCY, BODY WEIGHT, EGG WEIGHT, SHELL THICKNESS AND HAUGH SCORE,

Michigan State Univ., East Lansing. Dept. of Poultry Science.
C. J. Flegal, and H. C. Zindel.
In: Research Report 117, Farm Science, MSU Agricultural Experimental Station, July 1970, p 31-33. 3 tab.

Descriptors: *Farm wastes, *Poultry, *Dehydration, *Diets, Feeds, Eggs, Lipids, Efficiencies, Performance, Weight, Protein, Nitrogen.
Identifiers: *Production, *Feed efficiency, Body weight, Egg weight, Shell thickness, Haugh score, Significant difference.

In this egg production experiment, one replicate of 18 twenty-six-week-old Leghorn type pullets was placed on each of five different rations. The rations varied from 0% to 40% dehydrated poultry waste (DPW) plus fat. The production trial was conducted for 366 days with the birds in individual cages on a 15-hour-per-day light schedule. Protein-nitrogen supplied in each of the rations was calculated to be equal. The highest percent egg production resulted in those birds which received 10% DPW in the ration. Although production varied from 61.62% to 53.16% production, there was no significant difference in hen housed production. Feed efficiency again was inversely proportional to the amount of DPW in a ration, with the best efficiency having 0% DPW in the ration. However, an addition of animal fat to the ration resulted in a slight improvement in feed efficiency. It is also interesting to note that those birds which received more than 10% DPW in their diet did not increase in body weight comparable to the control ration. The egg weight became smaller as the percent of DPW was increased in the diet. These differences were not significantly different. Although there were slight differences in shell thickness, again there were no significant differences due to the diet in any of these rations. All of the experimental rations had a significantly higher Haugh score than the control diet. The Haugh scores ranged from 67.7 to 76.8. (White-Iowa State)

0212 - E3

THE EFFECT OF FEEDING DEHYDRATED POULTRY WASTE TO LAYING HENS ON THE TASTE OF THE RESULTING EGGS,

Michigan State Univ., East Lansing. Dept. of Poultry Science.
C. J. Flegal, H. C. Goan, and H. C. Zindel.
In: Research Report 117, Farm Service, MSU Agricultural Experiment Station, July 1970, p 34-38. 2 tab, 9 ref.

Descriptors: *Farm wastes, *Poultry, *Dehydration, Diets, Eggs, Evaluation, Taste, Control.
Identifiers: *Dehydrated poultry waste, Taste test, Consumer Preference Panel.

Poultry feces, from caged layers, were collected and dried. The resulting product was designated as dehydrated poultry waste (DPW). DPW was fed at dietary levels of 10, 20 and 30 percent to Single Comb White Leghorns in individual wire cages. A cage-type laying diet was used as a control. The diets were fed for four months before any eggs were collected for taste panel evaluation. Eggs from each treatment group were hard-cooked and prepared for a Consumer Preference Panel. The eggs were evaluated on the basis of taste difference and then ranked for preferred taste. The dietary levels of DPW fed had no significant (pA.05) effect on the taste of eggs. Panel members were unable to detect any consistent taste difference for the DPW and control eggs. Two thirds of the time, panel members liked the taste of the DPW eggs over the taste of the control eggs. In each ranking test, panel members preferred the control eggs over the DPW eggs. (White-Iowa State)

0213 - E3

ACCEPTABILITY AND DIGESTIBILITY OF POULTRY AND DAIRY-WASTES BY SHEEP,

Michigan State Univ., East Lansing.
J. W. Thomas.
In: Research Report 117, Farm Science, MSU Agricultural Experiment Station, July 1970, p 42-44. 2 tab.

Descriptors: *Farm wastes, *Poultry, *Sheep, *Cattle, Protein, Nitrogen, Animal metabolism, Digestion, Cellulose, Lignins, Fiber, Diets.
Identifiers: Total digestible nutrients, Dry matter, Digestibility, Soybean meal, Nutritive value.

Dried poultry and dairy wastes as about one third the total mixed ration were readily accepted by sheep. The complete ration was about 60% digestible with a TDN value of about 56. The digestibility of the poultry feces was more than that of the dairy feces. Protein of these wastes was less digestible than that of soybean meal but had a biological value equal to that of soybean meal for growing sheep. (White-Iowa State)

0214 - F4

RELATIONSHIP OF AGRICULTURE TO SOIL AND WATER POLLUTION.

Cornell Univ., Ithaca, N.Y.

Proceedings, Cornell University Conference on Agricultural Waste Management, January 19-21, 1970. Ithaca, 1970. 270 p.

Descriptors: *Soils, *Farm wastes, *Fertilizers, Groundwater, Precipitation, Potassium, Poultry, Cattle, Hogs, Nitrogen, Nitrate, Phosphorus, Phosphates, Rates of application, Nutrients, Effluent, Aquifer, Ammonia, Soil contamination, Water pollution, Water table, Oxidation lagoon, Irrigation, Aeration, Biochemical oxygen demand, Chemical oxygen demand, Odor, Biological treatment, Costs, Denitrification, Nitrification, Sludge, Storage, Nutrient requirements, Florida, Nebraska, Surface runoff, Infiltration.
Identifiers: *Feedlots, Oxidation ditch, Slotted floors, Aerator, Spreading, Land disposal.

The 1970 Conference attempted to bring knowledgeable individuals from many disciplines together to discuss various aspects of the problem. It was designed to serve as a mechanism for transmitting new research findings to those interested in this area and to demonstrate that agriculture is aware of its potential contributions to environmental pollution as well as its responsibility to society to find methods of alleviating such pollution while increasing the efficiency of production. The Conference played a useful role in providing communication across disciplines. Thirty-two papers are published in the proceedings dealing with all areas of agricultural pollution. (White-Iowa State)

0215 - B3, E2

MOVEMENTS OF NUTRIENTS FROM POULTRY MANURE IN SOIL,

Rutgers University.
J. E. Steckel.
Relationship of Agriculture to Soil and Water

Pollution; Proceedings, Cornell University Conference on Agricultural Waste Management, 1970, p. 30.

Descriptors: *Farm wastes, *poultry, soils, soil water, lysimeters, depth, precipitation, potassium, calcium, magnesium, sodium, nitrate, chlorine, sulfates, phosphates, rates of application.
Identifiers: *Plow-furrow-cover

Poultry manure was Plow-Furrow-Cover (PFC) applied at depths of 6 to 7 inches into Freehold sandy loam (20% clay in the B horizon) on June 6 1968. The application rates were 0, 15, 30 and 40 tons of water-free equivalent per acre. Soil water samples were taken with suction lysimeters of depths of 12, 18, 24, 36, and 48 inches. Chemical analysis of the water has included determinations of the contents of K, Ca, Mg, Na, NH_4-N, NO_3-N, NO_2-N, Cl, SO_4 and PO_4. Analytical data was presented from samplings of October 4, 1969 (391 days and 50 inches of rain after PFC). The October 14 sampling indicated increased element concentrations were again increased, even at the 48-inch depth. Data were presented on the amount of elements dissolved in the soil water for each of the 5 depths studied, and for the total in the 9 to 48-inch soil depth. (White-Iowa State)

0216 - A4, A9, C3

GROUNDWATER QUALITY AND FLUCTUATIONS IN A SHALLOW UNCONFINED AQUIFER UNDER A LEVEL FEEDLOT,
Department of Agriculture, Lincoln, Nebr.
L. N. Mielke, J. R. Ellis, N. P. Swanson, J. C. Lorimor, and T. M. McCalla.
In: Relationship of Agriculture to Soil and Water Pollution; Proceedings, Cornell University Conference on Agricultural Waste Management, Rochester, January 19-21, 1970, Ithaca, 1970, p 31-40. 2 tab, 4 fig, 13 ref.

Descriptors: *Farm wastes, *Cattle, *Groundwater, *Nitrate, Aquifer, Discharge, Aquifer characteristics, Effluent stream, Groundwater recharge, Transmissivity, Water level fluctuations, Ammonia, Nebraska, Soil contamination, Observation wells, Water table, Infiltration.
Identifiers: *Feedlot, Platte River Valley.

The quality was investigated of the groundwater in the proximity of a level feedlot on a permeable soil with fluctuating high water table. At the feedlot site, the aquifer consists of 30-35 feet of high quality gravel having a coefficient of transmissibility in the range of 90,000-120,000 gallons per day per foot. Aquifer recharge occurs as a result of direct precipitation and interflow from the valley uplands. Six observation wells were installed in the vicinity of the feedlot as well as six water level measuring wells. Two recording wells, constructed of 4-inch diameter aluminum irrigation pipe, were jetted into the gravel aquifer. The water table depth at the feedlot varies with the season. Groundwater level changes reflect major rainstorms within hours after the event. The maximum groundwater elevation under the feedlot was approximately 2 feet below the soil surface. Soil cores were taken to determine the quantity of nitrate which could move into the water table. Low levels of nitrate were found below the first foot. Ammonia was present in only moderate amounts below 3 feet (A30ppm) and rapidly decreased in concentration with increased depth to the water table. Analysis of the core samples indicated that downward movement of nitrates and other forms of nitrogen in the soil was minor. The 12-15 inches of manure pack decreased the actual penetration depth of the nitrogen into the profile. Some samples exhibited levels of nitrate that exceeded Public Health standards (10ppm). This may have been due to the application of anhydrous ammonia prior to the first irrigation. Generally, the nitrate analysis showed relatively low nitrate level in the profile.
(White-Iowa State)

0217 - A3, A4, A9, E2

POLLUTION FACTORS ASSOCIATED WITH EXCESSIVE POULTRY LITTER (MANURE) APPLICATION IN ARKANSAS,
Arkansas Univ., Fayetteville. Dept. of Agronomy.
Leslie H. Hileman.
In: Relationship of Agriculture to Soil and Water Pollution; Proceedings, Cornell University Conference on Agricultural Waste Management, Rochester, January 19-21, 1970, Ithaca, 1970, p 41-47. 9 tab, 1 fig, 3 ref.

Descriptors: *Farm wastes, *Poultry, Water pollution, Soil contamination, Rates of application, Soil tests, Phosphorus, Potassium magnesium, Salts, Ions, Nitrates.
Identifiers: *Poultry litter, Mono-valent ions, Divalent ions.

There is an estimated one million tons of poultry manure or manure plus litter produced from 390.. million chickens and turkeys grown in Arkansas annually. The waste manure-litter is being returned to the soil often at rates exceeding 10 tons per acre annually. The data presented indicates that soil pollution and related problems may occur. These problems can be considered as: (1) excess soluble salt, (2) chemical imbalance with particular reference to K and the mono-valent to di-valent ratio, (3) excessive nitrate production and accumulation to toxic levels in forage and farm water supplies, and (4) forages deficient in magnesium for adequate animal nutrition. Further studies are needed to understand the mechanisms by which these conditions are carried out in the soil medium so that effective measures can be taken to prevent soil and water pollution. (White-Iowa State)

0218 - A2, D4

REDUCING THE POLLUTION POTENTIAL OF LIVESTOCK WASTES WITH IN-THE-BUILDING OXIDATION DITCHES,
Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
D. L. Day.
In: Relationship of Agriculture to Soil and Water Pollution; Proceedings, Cornell University Conference on Agricultural Waste Management, Rochester, January 19-21, 1970. Ithaca, 1970, p 77-84. 11 fig, 3 ref.

Descriptors: *Farm wastes, Oxidation lagoon, Irrigation, Aeration, Biochemical oxygen demand, Odor, Aerobic treatment, Labor, Rotors, Denitrification, Coagulation, Effluent.
Identifiers: *Oxidation ditch, *Slotted floors, Aerator, Clarifier.

A low-odor, low-labor, system of managing livestock wastes from animal to field is discussed. The system consists of (1) a confinement building for livestock, with self-cleaning, slotted floors; (2) an oxidation ditch beneath the slotted floors; (3) a nonoverflow of mixed liquor from the oxidation ditch; and (4) irrigating equipment for removing surplus liquids and solids from the lagoon and distributing them on nearby land when convenient for the operator. This system greatly improves the quality of the waste water, but without further treatment the waste water would probably not meet quality criteria for the receiving water. Thus the main advantages of the system are: low labor, low odor, low stream-pollution potential, and operator convenience. (White-Iowa State)

0219 - B2, D4, F1

THE CONCEPTUAL DESIGN OF AN ECONOMICALLY FEASIBLE ANIMAL WASTE DISPOSAL SCHEME,
Resource Engineering Associates, Wilton, Conn.
R. W. Okey, and R. N. Rickles.
In: Relationship of Agriculture To Soil and Water Pollution; Proceedings, Cornell University Conference on Agricultural Waste Management, Rochester, January 19-21, 1970, Ithaca, 1970, p 85-97. 11 tab, 4 fig, 11 ref.

Descriptors: *Farm wastes, *Cattle, *Biological treatment, Treatment facilities, Capital costs, Operating costs, Installation costs, Sludge, Centrifugation, Denitrification, Phosphorus, Nitrogen, Incineration, Biochemical oxygen demand, Chemical oxygen demand.
Identifiers: *Feedlot, Population equivalent, Waste management, Clarifer, Transport system.

Based on earlier work, a complete system for the capture, transport and treatment of the wastes from a 25,000 animal lot was presented. System capital costs are seen to be about \$1.00 - \$2.00/ton, and operating costs are around \$3.00 - \$4.00 per ton of wet waste. These costs result in a cost/lb gained of less than half a cent to about a cent. The costs for the least expensive system are an order of magnitude below feed costs. The installation costs are in the order of \$15.00 to \$40.00/animal or less than the capital cost as the least expensive confinement scheme. Economic feasibility is a combination of many things. One of the most important is the relevance of a particular item when all the costs are considered. The costs of waste treatment at feedlots would appear to represent roughly the same fraction of the total costs as seen in other industries. (White-Iowa State)

0220 - B2, F1

THE ECONOMICS OF STORING, HANDLING AND SPREADING OF LIQUID HOG MANURE FOR CONFINED FEEDER HOG ENTERPRISES,
M. F. McKenna, and J. H. Clark.
In: Relationship of Agriculture to Soil and Water Pollution; Proceedings, Cornell University Conference on Agricultural Waste Management, Rochester, January 19-21, 1970, Ithaca, 1970, p 98-110. 12 tab.

Descriptors: *Farm wastes, *Hogs, *Storage capacity, Chemical analysis, Fertilizers, Storage tanks, Value, Soil contamination, Nitrogen, Phosphorus, Potassium, Nutrient requirements, Linear programming.
Identifiers: *Spreading, Seasonal application, Disposal costs.

The main hypothesis made at the outset of the study, that the economically optimal storage capacity would be affected by the density of hogs per acre and the crops under cultivation on the farm was supported. Of these two factors it was found that the ratio of hogs per acre was the more significant. For a spreading operation with the relatively high fixed costs associated with spreading, farms with smaller herd sizes were seen to encounter significantly higher spreading costs per hog than farms with larger herds. In some cases the extent of these costs will be sufficient to cancel out the positive value of the manure as a replacement for commercial fertilizer. It would therefore appear that significant savings might be realized if hog operators were to enter rental or custom arrangements for manure spreading. The overall conclusion reached in the study was that for Ontario conditions a land utilization program for the liquid manure supply does represent an economic means of handling the animal waste management problem.
(White-Iowa State)

0221 - E3

LAND DISPOSAL OF DAIRY FARM WASTE,
Florida Univ., Gainesville. Dept of Agricultural Engineering.
A. R. Overman, C. C. Hortenstine, and J. M. Wing.
In: Relationship of Agriculture to Soil and Water Pollution; Proceedings, Cornell University Conference on Agricultural Waste Management, Rochester, January 19-21, 1970, Ithaca, 1970, p 123-126. 3 fig, 2 ref.

Descriptors: *Farm wastes, *Cattle, Dairy industry,

Effluent, Nitrogen, Phosphates, Soil contamination, Groundwater, Water pollution, Florida, Sprinkler irrigation, Rates of application, Nitrate, Oats, Waste disposal.
Identifiers: *Dairy cattle, Land disposal.

Wastes from 160 cows in a new milking barn at the University of Florida are collected in a 20,000-gallon holding tank and removed daily. An open impeller pump is used to deliver effluent to sprinkler guns which apply 1/4, 1/2, and 1 inch per week. The plots were seeded to oats, with no mineral fertilizer added. Measurements were taken to determine effectiveness of the oats in utilizing nutrients. Groundwater samples were extracted weekly at depths of 30,45, and 60 cm. for chemical analysis. Results are reported for nitrate and orthophosphate content. It is concluded that the soil plant system can be effective in renovation of waste water farm animal operations. Removal of nitrogen and phosphorus is greatly enhanced by plant growth. Nutrient removal was found adequate up to an application rate of 1 inch per week effluent with solids content of about 0.115 percent. It appears that a more intense application rate could be used. (White- Iowa State)

0222 - A4, C3

THE NITROGEN CYCLE OF A DAIRY FARM,
Connecticut Agricultural Experiment Station, New Haven.
C. R. Frink.
In: Relationship of Agriculture to Soil and Water Pollution; Proceedings, Cornell University Conference on Agricultural Waste Management, Rochester, January 19-21, 1970, Ithaca, 1970, p 127-133. 4 fig, 1 tab, 11 ref.

Descriptors: *Nitrogen, *Nitrogen cycle, Farm wastes, Nutrients, Fertilization, Foliar application, Corn, Silage, Efficiencies, Nitrate, Groundwater, Ureas.
Identifiers: *Nitrogen conversion, Yield, Foliar fertilization.

Analyses of nutrient cycling on dairy farms in the Northeast have shown that significant quantities of nitrogen may be lost to groundwater. Calculations of the efficiency of nitrogen conversion on these farms revealed that losses to the environment increased dramatically as farm size decreased. Milk production was not affected by the increased nitrogen imported onto the farm while yields of corn silage increased only slightly. Thus, the total nitrogen imported onto the smaller farms could apparently be reduced without seriously reducing productivity. In addition, losses to the environment during cycling of the required amounts of nitrogen can be reduced by foliar applications to the growing crop, selection of varieties with high yield and nitrogen content, increased plant populations, and more extensive use of cover crops.
(White-Iowa State)

0223 - B1, C3, E2

NITROGEN TRANSFORMATIONS AND PLANT GROWTH AS AFFECTED BY APPLYING LARGE AMOUNTS OF CATTLE FEEDLOT WASTES TO SOIL,
Southwestern Great Plains Research Center, Bushland, Tex.
A. C. Mathers, and B. A. Stewart.
In: Relationship of Agriculture to Soil and Water Pollution; Proceedings, Cornell University Conference on Agricultural Waste Management, Rochester, January 19-21, 1970, Ithaca, 1970, p 207-214. 8 fig, 2 tab, 3 ref.

Descriptors: *Farm wastes, *Cattle, *Nitrification, Denitrification, Nitrate, Nitrogen, Ammonia, Carbon dioxide, Greenhouses, Laboratories, Carbon, Rates of application, Incubation, Phosphorus, Potassium.
Identifiers: *Feedlots, *Nitrogen transformations, Pullman silty clay loam, Yield.

The objectives of these studies were: (1) to determine the decomposition rates and nitrogen transformations of animal wastes when applied to soil at various rates; and (2) to study the effects on plant growth of applying large amounts of animal wastes to soil. Studies were carried out with 0, 1, 2.5, 5, 10, and 20% rates of cattle feedlot waste added to Pullman silty clay loam in both laboratory and greenhouse tests. Three conclusions were reached: (1) When feedlot waste was mixed with soil, evolution of C and transformation of N were rapid. In 90 days, about 50% of the C was evolved as CO2 and an equivalent amount of N was recovered as NH3 evolved, or as NH4.. and NO3- in the soil. (2) Nitrification was influenced by application rate of manure and moisture content of the soil during incubation. (3) In a greenhouse study, one unit of N from ammonium nitrate was equivalent to 2.4 units of N supplied in feedlot waste.
(White-Iowa State)

0224 - A2

HYDROLOGIC STUDIES FOR EVALUATION OF THE POLLUTION POTENTIAL OF FEEDLOTS IN EASTERN NEBRASKA,
Department of Agriculture, Lincoln, Nebr.
Norris P. Swanson, Lloyd N. Mielke, and Jeffery C. Lorimor.
In: Relationship of Agriculture to Soil and Water Pollution; Proceedings, Cornell University Conference on Agricultural Waste Management, Rochester, January 19-21, 1970, Ithaca, 1970, p 226-232. 15 ref.

Descriptors: *Farm wastes, *Cattle, *Runoff, Overland flow, Surface runoff, Infiltration. Water pollution, Erosion, Evaporation, Discharge, Settling basins, Precipitation, Slopes, Storage, Time, Nebraska.
Identifiers: *Feedlots, Mulch, Water stage recorder, Manure pack, Intensity.

Four questions are discussed which arise as a result of large numbers of cattle contained in feedlots in eastern Nebraska. There were two primary objectives of the research. First, the annual water balance of the feedlots was to be defined. The second objective was to characterize the water leaving the feedlots in overland flow or by percolation through the profile. The data collected provide only rough comparison, but should serve to put the probable runoff, erosion, and infiltration, or retention of water on a feedlot into perspective with the better known hydrologic characteristics of cropped land. In eastern Nebraska, this can be summarized as follows: (1) Infiltration on an established beef feedlot appears to be restricted to water storage in the manure pack, with very limited water movement through the profile; (2) the runoff from a feedlot, and hence the pollution potential, is a function of the area of the lot; (3) annual runoff from a beef feedlot may be two or three times that of adjacent cropland, and (4) despite increased runoff in comparison adjacent cropland, the protective mulch of the manure pack keeps erosion losses below those of the cropland.
(White-Iowa State)

0225 - A3, F1

LEGAL RESTRAINTS ON AGRICULTURAL POLLUTION,
Virginia Polytechnic Inst., Blacksburg. Water Resources Research Center.
William R. Walker.
In: Relationship of Agriculture to Soil and Water Pollution; Proceedings, Cornell University Conference on Agricultural Waste Management, Rochester, January 19-21, 1970, Ithaca, 1970, p 233-241. 31 ref.

Descriptors: *Water pollution, *Farm wastes, Water Quality Act, Legislation, Discharge, Pesticides, Riparian rights, Odors, Zoning.
Identifiers: *Agricultural pollution, *Common law, State regulations, Federal regulations, Equity, Trespass, Liability, Nuisance, Negligence, Strict liability.

The basis is discussed for recovery under common law for agricultural pollution. These include actions for trespass, nuisance, negligence, and strict liability. However, agricultural pollution is not likely to be effectively controlled with private litigation. The federal government has the necessary legislation to play a leading role in agricultural water pollution abatement and it is designed to encourage the states to take a more aggressive role. Public awareness of the seriousness of the pollution problem in general is ever increasing. State laws banning the use of DDT, and HEW decisions to phase out the use of some of the persistent pesticides would indicate that public pressure for action in the field of agricultural pollution will be increasing. Thus there would seem to be little doubt that the law has a continuing and expanding role to play if agricultural pollution is to be controlled.
(White-Iowa State)

0226 - A3, C3

A BALANCE SHEET METHOD OF DETERMINING THE CONTRIBUTION OF AGRICULTURAL WASTES TO SURFACE WATER POLLUTION,
Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Economics.
David A. Schultz.
In: Relationship of Agriculture to Soil and Water Pollution; Proceedings, Cornell University Conference on Agricultural Waste Management, Rochester, January 19-21, 1970, Ithaca, 1970, p 251-262. 8 tab, 9 ref.

Descriptors: *Water quality, *Farm wastes, *Nutrients, Nitrogen, Phosphorus, Potassium, Fertilizers, Water pollution, Sediments, Pesticides, Regions, Basins, Time.
Identifiers: *Balance Sheet Method, Nutrient losses, Biologic inputs.

To the extent that the data are accurate, the paper presents a Balance Sheet Method that will show explicitly the quantity of nutrients contributed by agricultural activities to a stream. From this, one can determine the relative importance of agricultural pollution given knowledge of the total amount of nutrient pollution. Combining this information with that available on water quality and contributions from other sources, a waste management association will be able to more accurately determine the share that the agricultural industry will have to pay of the total cost of a program to maintain an abundant quantity of good quality water for all uses. Using this general method as well as modifying and improving the procedure will aid society's efforts toward effective water pollution control for all rivers and lakes in the United States.
(White-Iowa State)

0227 - C2, E2

RATES OF WATER INFILTRATION RESULTING FROM APPLICATIONS OF DAIRY MANURE,
Cornell Univ., Ithaca, N.Y. Dept. of Agronomy.
P. J. Zwerman, A. B. Drielsma, G. D. Jones, S. D. Klausner, and D. Ellis.
In: Relationship of Agriculture to Soil and Water Pollution; Proceedings, Cornell University Conference on Agricultural Waste Management, Rochester, January 19-21, 1970, Ithaca, 1970, p 263-270. 6 tab, 17 ref.

Descriptors: *Farm wastes, *Cattle, *Infiltration, Time, Corn, Alfalfa, Wheat, Rotations, Rainfall simulators, Rates of application, Fertilizers, Sur-

face runoff, Rainfall.
Identifiers: *Dairy cattle, Intensity, Plots, Mass infiltration.

Sixty randomly selected plot locations were subject to infiltration tests with a rainfall simulator. Three successive tests of one half hour each were applied to the same plot. These results represent the effects of fourteen years of past management on seed beds prepared for corn. The rainfall rate was two and one half inches per hour. A two-by-two factorial and a two-by-four factorial experimental design were utilized. The two-by-two comparisons involved six tons of dairy manure plowed down versus no manure on continuous corn for grain at two rates of mineral fertilization. Manure increased infiltration by 27 percent, heavy mineral fertilization without manure on the last run resulted in a 60 percent decrease in infiltration as compared to manure with moderate mineral fertilization. The two-by-four factorial study again involved six tons of manure plowed down versus no manure on four rotations: (1) continuous corn for grain, (2) corn-oats-alfalfa-alfalfa, (3) corn-corn-oats-alfalfa-alfalfa, and (4) wheat-alfalfa-alfalfa-alfalfa-alfalfa. Manure did not significantly increase rates of infiltration. All rates of fertilization were very moderate. Only rotation No. 4 gave a significant 16 percent increase in rate of infiltration.
(White-Iowa State)

0228 - A5, F3

RAISING LIVESTOCK IN THE URBAN FRINGE,
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
J. Ronald Miner.
Agricultural Engineering, Vol 51, No 12, p 702-703, December 1970.

Descriptors: *Odor, *Pollution abatement, Farm wastes, Pollutants, Legal aspects, Livestock, Planning management.
Identifiers: Urban-fringe.

More people in this country demand more and better-quality livestock production. However, the population is extremely sensitive to water and air quality. The livestock producer should recognize that there will soon be no livestock production area where environmental pollution is acceptable. All livestock production enterprises must be planned as though they will operate in the urban fringe. Livestock production units can and do cause pollution of the air and waterways if improperly managed. The most frequent complaint leveled at urban-fringe livestock production is that of odors. Through proper design and management the livestock operations may be made acceptable to the public. (Christenbury-Iowa State)

0229 - F4

THE FARM ROLE IN WATER QUALITY MANAGEMENT,
Soil Conservation Service, Beltsville, Md.
Hollis R. Williams.
Water and Sewage Works, Vol 115, October 1968, p 463-464.

Descriptors: *Farm wastes, *Sediments, *Fertilizers, Insecticides, Herbicides, Water pollution, Watershed Protection and Flood Prevention Act, Channels, Cattle, Poultry, Pollution abatement.
Identifiers: Soil Conservation Service.

This article is based on information contained in an address by Williams to the Federal Water Quality Association. It is stated that three things find their way from farm lands into waterways to form major pollution problems. These are sediment, agricultural chemicals, and animal wastes. Sediment is the most significant of the three. Sediment also adsorbs phosphate and pesticides and carries them in streams. The major source of sediment is farmland, however, housing developments, new roads and other construction produces extremely large quantities of sediment. Four areas are mentioned which need continuing attention to control the erosion problem. The increased use of fertilizer is pointed out along its pollution capabilities. Research is currently being done to study the behavior of fertilizers, insecticides and herbicides on soils, water and plants. The problem of animal waste is also discussed. Four tools are pointed out as being necessary to achieve the goal of clean rivers and streams and successful control of pollution on farmlands as well as urban areas. (White-Iowa State)

0230 - A1, B1, D1, F4

CATTLE WASTES - POLLUTION AND POTENTIAL TREATMENT,
Kansas Univ., Lawrence. Dept. of Civil Engineering; and Kansas Univ., Lawrence. Environmental Health Engineering Lab.
Raymond C. Loehr, and Robert W. Agnew.
Journal of the Sanitary Engineering Division, ASCE, Vol 93, No SA4, p 55-72, August 1967. 2 fig, 9 tab, 29 ref.

Descriptors: *Farm wastes, *Cattle, *Water pollution sources, Rivers, Fishkill, Moisture content, Biochemical oxygen demand, Chemical oxygen demand, Nitrogen, Anaerobic digestion, Oxygen demand, Lagoons, Hydrogen ion concentration, Effluent, Aeration, Sludge, Runoff, Waste water treatment.
Identifiers: *Feedlots, Cattle production, Pollution potential, Loading rages, Profit potential, Waste characteristics, Total solids, Population equivalent, Digesters, Anaerobic lagoons.

The problem of cattle feedlot waste treatment and the results illustrated in this paper can be summarized as follows: The diversified family farm is giving way to specialized large-scale factory-type operations such as beef cattle feedlots. Farm enterprises which formerly were dispersed over large remote land areas are now concentrated in small areas, frequently near communities, and intensify problems of waste disposal. Runoff from feedlots is a significant problem and treatment systems must be able to handle slug loads and flows without causing stream pollution. The profit potential and the amount of concern of the feedlot operator for adequate waste treatment will dictate the type of system that will be practical and economical. The quantity and the undesirable qualities of the wastes from a beef feedlot are such that a combination treatment system may be the most successful. A combined anaerobic-aerobic lagoon system has significant potential. The effluent from an anaerobic lagoon is potent and must receive further treatment before discharge to a receiving stream. Even after adequate removal of organics, the effluent may pose a problem because of its color and its fertilization capacity. (White-Iowa State)

0231 - C5

THE INFLUENCE OF FEED ADDITIVES ON THE BIOCHEMICAL OXYGEN DEMAND ANALYSIS FOR SWINE WASTES,
North Carolina State Univ., Raleigh. Dept. of Biological and Agricultural Engineering.
John David Ariail.
Master of Science Thesis, 1970. 72 p, 12 fig, 44 ref. OWRR Project A-048-NC (1).

Descriptors: *Farm wastes, *Hogs, *Lagoons, *Biochemical oxygen demand, Chemical oxygen demand, Water properties, Copper, Zinc, Wastes, Lagoons, Manure, Waste water treatment, Waste identification.
Identifiers: *Swine wastes, Swine feces, Chlorotetracycline, Fecal streptococcus.

The influence of feed antibiotic, chlorotetracycline, copper and zinc concentrations and sample dilution upon the standard 5-day biochemical oxygen demand (BOD5) analysis was investigated with swine feces, lagoon influent and lagoon effluent. The swine-growing center utilized for sample collection included a confinement facility with concrete floors that were washed daily and an unaerated overflow lagoon. The data indicated the mean COD/TS ratio for fresh swine feces to be 1.08 grams per gram, the BOD5/TS ratio to have a mean of 0.33 grams per gram, and the VS/TS ratio to have a mean of 0.82. This study indicated that for a 100 lb. hog, the daily COD in the waste was 0.64 pounds; BOD 0.31 pounds; total solids 0.48 pounds and volatile solids 0.33 pounds. The membrane filter technique outlined in Standard Methods for the determination of the fecal streptococcus content of swine wastes was superior to the membrane filter technique utilizing KF broth. (Miner-Iowa State)

0232 - A2, C3, C5, E3

CONTROL OF WATER POLLUTION FROM SOUTHWESTERN CATTLE FEEDLOTS,
Texas Tech Univ., Lubbock. Water Resources Research Center.
D. M. Wells, W. Grub, R. C. Algin, G. F. Meenaghan, and E. Coleman.
Proceedings, 5th International Water Pollution Research Conference, July-August 1970, Paper II-38. 19 p, 20 tab. FWPCA Demr. Grant 13040, Texas Water Quality Board Contr. IAC (68-69).

Descriptors: *Farm wastes, *Cattle, *Manure, *Runoff, Biochemical oxygen demand, Nutrients, *Aerobic treatment, Anaerobic digestion, Irrigation, Waste water treatment.
Identifiers: *Feedlot runoff, Plant toxicity.

The objectives were to determine the characteristics of solid and liquid wastes resulting from cattle feedlot operations in the southwest U.S., to determine the treatability of these wastes by aerobic and anaerobic treatment systems and to determine whether or not the wastes produced could be used in a beneficial manner for the growing of cash crops. The feedlots studied included concrete-surfaced lots, dirt-surfaced lots, and controlled environmental chambers located on the Texas Tech University campus. Among their conclusions were that within reasonable limits, quality of runoff was not materially affected by type of ration fed or quantity of precipitation. Treatment of runoff resulting from precipitation on beef cattle feedlots is not feasible by conventional treatment systems. Direct application of runoff from concrete-surfaced lots was highly detrimental to the crops they tested. Direct application of runoff from dirt lots had an inhibitory effect on most crops tested except Midland Bermuda grass. Storage of runoff in unlined ponds may result in substantial pollution of the groundwater in the vicinity. They concluded that liquid systems for handling cattle feedlot wastes were not feasible. (Miner-Iowa State)

0233 - A2, A4, C1, D4, E2

EFFLUENT QUALITY FROM ANAEROBIC LAGOONS TREATING FEEDLOT WASTES,
Kansas Univ., Lawrence. Dept. of Civil Engineering.
Raymond C. Loehr.
Journal Water Pollution Control Federation, Vol 39, No 3, March 1967, p 384-391. 6 tab, 12 ref.

Descriptors: *Farm wastes, *Cattle, *Lagoons, Kansas, Biochemical oxygen demand, Odor, Dusts, Groundwater, Surface waters, Water pollution, Volume, Value, Soil environment, Temperature, Biodegradation, Anaerobic conditions, Mixing, Depth, Stabilization, Organic matter, Color, Nitrogen, Ammonia, Coliforms, Alkalinity, Hydrogen ion concentration, Equilibrium, Waste water treatment.
Identifiers: *Feedlots, *Anaerobic lagoons, Population equivalent, Slug load, Lagoon operation, Biological system, Surface area/volume ratio, Loading parameters, Volatile solids, Detention times.

Even under ideal equilibrium conditions, the liquid effluent from anaerobic lagoons treating livestock and feedlot wastes could pollute a receiving body of water. The quality of the effluent is decreased during the startup operations. The effluent is high in oxygen-demanding material, solids, and nitrogen. Subsequent treatment units are advisable to remove the solids and most of the oxygen-demanding material. Seasonal temperature variations will alter the effluent quality. The settled solids that need to be removed periodically from the anaerobic lagoon undergo considerable degradation, stabilization, and concentration. They are less potent than the entering untreated solids. However, their quality is such that they should not enter receiving waters. Land disposal offers an acceptable method of disposal for these solids. Anaerobic lagoons are not the complete answer to avoiding the pollution of natural waters by livestock and feedlot wastes. When used in combination with subsequent units to treat the effluent from the lagoons, anaerobic lagoons may be useful component process for livestock and feedlot wastes that have a high solids content. (White-Iowa State)

0234 - F4

FARM WASTES.

Proceedings of Symposium, Farm Wastes, The Institute of Water Pollution Control, The University of Newcastle upon Tyne, 1970. 148 p.

Descriptors: *Farm wastes, Disposal, Legislation, Slurries, Composting, Disease, Legal aspects, Hazards, Toxicity, Public health, Odors, Costs, Design criteria, Treatment, Adsorption, Reverse osmosis, Confinement pens, Hogs, Equipment, Microorganisms, Farm lagoons, Irrigation, Aeration, Aerobic treatment, Anaerobic treatment, Biochemical oxygen demand, Chemical oxygen demand, Biological treatment.
Identifiers: Health, Public nuisance, Population equivalents, Swine, Slatted floors, Oxidation ditch, Flushing gutter, Systems, Gas production, United Kingdom.

The two day symposium was attended by over 200 delegates including representatives from local authorities, river authorities, universities, agricultural colleges and research stations, nationalized industries and consultants. The various Ministries were well represented, with over 60 delegates. Those attending included delegates from Canada, Denmark, Eire, Holland and the United States. Nineteen technical papers were presented. A discussion of each paper is included. Four sessions were conducted: An introductory session, 4 papers; Problems off the farm, 3 papers; Minimizing the waste problem, 7 papers; and Waste treatment and disposal on the farm, 5 papers.
(Christenbury-Iowa State)

0235 - F4

ORIGINS AND NATURE OF FARM WASTES,

National Agricultural Advisory Service, London (England).
K. B. C. Jones, and C. T. Riley.
Proceedings of Symposium: Farm Wastes: The Institute of Water Pollution Control and The University of Newcastle upon Tyne, Paper No 1, p 7-14, 1970. 9 tab.

Descriptors: *Farm wastes, *Disposal, Rain water, Costs, Cattle, Hogs, Poultry, Planning, Legislation, Legal aspects, Economics, *Waste disposal.
Identifiers: *United Kingdom, Washing-down water, Nature of waste, Population equivalents, Origins of waste.

Waste disposal is discussed in relation to population expansion, diminishing acres, declining numbers of agriculture workers, economic pressures, limited natural water resources, and legal pressures. The origin and nature of the wastes that must be disposed of is discussed. The trends in planning and disposal patterns taking place were considered. The costs associated with disposal were examined in relation to the income produced. Food processing waste has created some disposal problems for farmers. The disposal problems created by fruit and meat processing are discussed in the last portion of the paper.
(Christenbury-Iowa State)

0236 - F3

ORIGINS AND NATURE OF FARM WASTES: DISCUSSION,

Gowan, Douglas.
Douglas Gowan.
Proceedings of Symposium: Farm Wastes: The Institute of Water Pollution Control and The University of Newcastle upon Tyne, Paper No 2, p 15-18, 1970. 1 tab.

Descriptors: Farm wastes, Disposal, Legislation, Discharge (Water), Sewers.
Identifiers: River authorities, Extensive farmer, Intensive farmer, United Kingdom, Public sewers.

Disposal of farm waste has become a major problem. A wholehearted effort is needed to deal with the problem, involving men, laboratories, and money. Also the farmers themselves must lend practical assistance. The law is there, and social and economic pressures are unlikely to ease. Nor is farming going to become less intensive, when this is the only way to profit, and the increasing public demand for food exists. All must combine to make sure that our inherent desire for increased water resources and pleasant-looking and smelling countryside facilities are one day realized.
(Christenbury-Iowa State)

0237 - E2

THE PROBLEM OF DISPOSAL OF FARM WASTES, WITH PARTICULAR REFERENCE TO MAINTAINING SOIL FERTILITY,

National Agricultural Advisory Service, Bristol (England). Soil Science Dept.
C. Berryman.
Proceedings of Symposium: Farm Wastes: The Institute of Water Pollution Control and The University of Newcastle upon Tyne, Paper No 3, p 19-23, 1970. 4 tab, 4 ref.

Descriptors: *Disposal, *Slurries, *Fertility, Farm wastes, Anaerobic conditions, Nutrients, Irrigation, Value, Fertilizers, Waste disposal.
Identifiers: *Animal slurry, *Composition, Organic irrigation.

This paper reviews the effect of farm waste, particularly in the form of animal slurry, on soil fertility. Slurry can supply an important part of the NPK requirements on the farm. The application of slurry to land is the most convenient and practical method of disposal, but problems due to a breakdown of soil structure can occur if an unsuitable soil receives excessive applications of slurry. The soil type is important when assessing the effect slurry disposal will have on the fertility of soil.
(Christenbury-Iowa State)

0238 - A9

THE PROBLEM ON THE FARM: ANIMAL HEALTH,

Ministry of Agriculture, Fisheries and Food, Norwich (England). Veterinary Investigation Service.
J. A. J. Venn.
Proceedings of Symposium: Farm Wastes: The Institute of Water Pollution Control and The University of Newcastle upon Tyne, Paper No 4, p 24-29, 1970. 41 ref.

Descriptors: *Toxicity, *Hazards, *Diseases, Farm wastes, Copper, Nitrogen, Potash, Lagoons, Slurries, Animal diseases, Bacteria, Viruses, Pathogenic bacteria.
Identifiers: United Kingdom, Toxic gases, Toxic chemicals, Parasites, Contamination, Health.

Health hazards associated with farm wastes have attained prominence with the development of intensive systems of husbandry. Whilst certain of the problems are unique to intensive systems, most of them are not new. This paper is an attempt to indicate some of them. An account is given of certain hazards to animal health arising from farm wastes, notably slurry and toxic chemicals. Possible ways of limiting these hazards are suggested. A discussion of the paper follows.
(Christenbury-Iowa State)

0239 - A9, A10

FARM WASTES: PUBLIC HEALTH AND NUISANCE PROBLEMS OFF THE FARM,

Chelmsford Rural District (Essex). Chief Health Inspector.
T. H. C. Bartrop.
Proceedings of Symposium: Farm Wastes: The Institute of Water Pollution Control and The University of Newcastle upon Tyne, Paper No 5, p 33-37, 1970. 5 ref.

Descriptors: *Public health, *Legislation, Farm wastes, Odors, Diseases, Bacteria.
Identifiers: *Public nuisance, Noise, Rats, Flies.

All nuisances and public health problems are preventable. To achieve this it is necessary to couple good siting and good design with good animal husbandry. Failure to do this voluntarily must inevitably lead to stricter planning control and the strengthening of public health law, for the development of intensive farming has outstripped controlling legislation. Agriculture, as an industry, claims certain privileges, but it cannot claim the privilege of causing a nuisance or a public health problem. (Christenbury-Iowa State)

0240 - A3, F2

WATER POLLUTION PREVENTION REQUIREMENTS IN RELATION TO FARM-WASTE DISPOSAL,

Thames Conservancy (England). Chief Purification Officer.
H. Fish.
Proceedings of Symposium: Farm Wastes: The Institute of Water Pollution Control and The University of Newcastle upon Tyne, Paper No 6, p 38-43, 1970.

Descriptors: *Farm wastes, *Legal aspects, Biochemical oxygen demand, Water pollution sources, Water quality control, Runoff, River regulation, Riparian waters, Groundwater, Legislation, *Disposal.
Identifiers: *United Kingdom, River authority, Common Law.

This article is concerned with the legal aspects of pollution and how they apply to agriculture. The ways in which farm waste can pollute water supplies and means of limiting the pollution effects are discussed. Large units located in close proximity to urban areas present the most difficult problems. Through cooperation between farmers and the river authority, the pollution effects of farm waste can be held at a minimum.
(Christenbury-Iowa State)

0241 - F1

SEWERS AND SEWAGE TREATMENT,

Chartered Civil Engineers, London (England); Newcastle-upon-Tyne Univ. (England).
James R. Simpson, and R. L. Hibberd.
Proceedings of Symposium: Farm Wastes: The Institute of Water Pollution Control and The University of Newcastle upon Tyne, Paper No 7, p 44-51, 1970. 2 fig, 2 tab, 13 ref.

Descriptors: *Costs, *Design criteria, *Sewage treatment, Farm wastes, Biochemical oxygen demand, Legislation, Dissolved solids, Tertiary treat-

ment, Sewers, Activated sludge, Capital cost.
Identifiers: River authority, Loading rates, Mogden formula, United Kingdom, Population equivalents, Suspended solids.

The purpose of this paper is to aquaint those unfamiliar with sewerage and sewage treatment with the general nature of the systems and processes. References to more detailed descriptions of the processes are included. Further, an attempt is made to answer the questions, 'Why and to what extent would a discharge with given characteristics affect the design of the sewers and the sewage-treatment works, and at what cost.' A formula for allocating waste treatment cost to agriculture is discussed. A discussion of the paper is included.
(Christenbury-Iowa State)

0242 - F5

MINIMIZING THE WASTE DISPOSAL PROBLEM IN VEGETABLE PROCESSING,
Electricity Council Research Center, Capenhurst (England).
F. Barrett.
Proceedings of Symposium: Farm Wastes: The Institute of Water Pollution Control and The University of Newcastle upon Tyne. 1970. Paper No 8, p 57-65. 7 fig, 4 tab.

Descriptors: *Apparatus, *Adsorption, *Reverse osmosis, Farm wastes, Desalination, Chemical oxygen demand, Recirculated water, Aeration, Flotation, Chlorination, Ultraviolet radiation, Biochemical oxygen demand, Equipment, Ozone, Biological treatment, Sludge disposal, Treatment.
Identifiers: *Food processing, Sterilization, Ozonation, United Kingdom, Vegetable processing.

This paper discusses possible mentods of treating waste from vegetable processing plants. The results obtained from a coagulation/flocculation unit have been encouraging. An aeration tower complex has been utilized for biological treatment. A pilot-scale adsorption unit and a reverse osmosis unit have been designed, built, and evaluated. A discussion and the reply to the discussion follows on page 106-109. (Christenbury-Iowa State)

0243 - B1, E1, F1

MINIMIZING POULTRY WASTE PROBLEMS,
National Agricultural Advisory Service, London (England).
C. T. Riley.
Proceedings of Symposium: Farm Wastes: The Institute of Water Pollution Control and The University of Newcastle upon Tyne. 1970. Paper No 9, p 66-72. 3 fig, 5 tab, 1 ref.

Descriptors: *Farm wastes, *Poultry, *Disposal, Costs, Biochemical oxygen demand, Odor, Land use, Sludge, Chemical properties, Physical properties, Fertilizers.
Identifiers: Composition, Hatchery waste, Broilers, United Kingdom.

This paper is divided into two parts; first an assessment of the industry and second an approach to some current problems. Manure from cage layers represents the major disposal problem in the poultry industry today. The physical and chemical properties of waste is given. In the main, poultry waste has to be returned to the land in some form. The disposal of manure from laying batteries is discussed in relation to minimizing the poultry-waste problems. Whether to handle the manure as a solid or liquid is examined. A discussion and reply to the discussion follows on page 106-109.
(Christenbury-Iowa State)

0244 - B1

MINIMIZING THE WASTE PROBLEM WITH PIGS,
National Agricultural Advisory Service, London (England).
C. G. Pointer.
Proceedings of Symposium: Farm Wastes: The Institute of Water Pollution Control and The University of Newcastle upon Tyne. 1970. Paper No 10, p 73-80. 7 fig.

Descriptors: *Confinement pens, *Design standards, *Hogs, Farm wastes, Slurries, Odor, Cleaning.
Identifiers: *Swine, Slatted-floor, Slurry systems, Sow feeders, Fattening house, Farrowing, United Kingdom, Manure handling, 'Ad-lib' feeding.

The first step towards minimizing the problems will be in the choice of site for the new pig unit. The larger the unit the more critical this decision will be. Subsequently the management and housing systems selected must be suited to the site. Systems have been described in this paper which minimize the problems. In existing problem units common sense and discretion can often avoid acute situations developing. It is hoped that economic solutions for these units will be evolved. In any event, there is always likely to be some smell from a piggery. A discussion and the reply to the discussion follows on page 106-109.
(Christenbury-Iowa State)

0245 - F4

MINIMIZING THE WASTE PROBLEM WITH CATTLE,
Newcastle-upon-Tyne Univ. (England).
M. M. Cooper.
Proceedings of Symposium: Farm Wastes: The Institute of Water Polution Control and The University of Newcastle upon Tyne. 1970. Paper No 11, p 81-83.

Descriptors: *Farm wastes, *Slurries, *Disposal, Cattle, Costs, Confinement pens.
Identifiers: *Cubicle system, Cowtels, United Kingdom.

This paper discusses some of the changes taking place in the cattle industry and the requirements for waste disposal. Many cattle producers require confinement areas for cattle for at least part of the year. Some of the systems being utilized for waste disposal are discussed. A discussion and the reply to the discussion follows on page 106-109.
(Christenbury-Iowa State)

0247 - B1, E1, F1

BUILDING DESIGN AND MANURE DISPOSAL,
Institutt voor Landbouwbedrijfsgebouwen, Wageningen (Netherlands).
J. C. Glerum, A. P. S. De Jong, and H. R. Poelma.
Proceedings of Symposium: Farm Wastes: The Institute of Water Pollution Control and The University of Newcastle upon Tyne. 1970. Paper No 13, p 94-100 3 fig, 3 tab.

Descriptors: *Farm wastes, *Disposal, *Costs comparison, Cattle, Storage tanks, Slurries, Storage capacity, Design criteria.
Identifiers: Mucking-out, Mixed storage, Separate storage, Animal housing, Cubicle house.

In general, slurry systems are preferable to systems for handling solids and urine separately. Special reasons, for example difficulty in disposing of the manure, can cause separate storage to be used. If mixed storage is used the layout of the buildings must be adapted to the specific requirements of this system. Altering the buildings afterwards will usually be very expensive. The high capital cost of the slurry system will often be a drawback; this is especially the case for cowhouses where a considerable storage capacity is required. A discussion and the reply to the discussion follows on page 106-109. (Christenbury-Iowa State)

0248 - D4, E3

PIGGERY CLEANING USING RENOVATED WASTES,
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
R. J. Smith, T. E. Hazen, and J. R. Miner.
Proceedings of Symposium: Farm Wastes: The Institute of Water Pollution Control and The University of Newcastle upon Tyne. 1970. Paper No 14, p 101-105. 1 fig, 13 ref. Grant EC 00283.

Descriptors: *Disposal, *Equipment, *Oxidation lagoons, Farm wastes, Design criteria, Confinement pens, Management, Recirculated water, Anaerobic conditions, Slurries, Sludge, Microorganisms.
Identifiers: *Oxidation ditch, *Flushing gutter, Manure removal.

A full-scale study of the possibility of renovating swine manure for use in manure transport was carried out. Preliminary anaerobic treatment and settling took place in a lagoon followed by secondary treatment in an oxidation ditch. Measurements of COD, BOD, nitrogen, solids and certain inorganic salts were made during the period February to May 1969. Assessment of the results showed that the system had considerable promise from the standpoint of confinement house environmental improvement and labour reduction. A stable and sanitary effluent was obtained at all times which showed no adverse effects upon the performance of the animals exposed to it. Rainfall precluded useful information being obtained concerning salt build-up or toxicity in the treatment system. No toxicity effects were apparent after continuous operation for 20 weeks. The test was terminated because of mechanical failures. A discussion and the reply to the discussion follows the paper on page 106-109.
(Christenbury-Iowa State)

0249 - B1, E2

LAND DISPOSAL AND STORAGE OF FARM WASTES. 1. PLANNING AND CHOICE OF SYSTEM,
National Agricultural Advisory Service, London (England). County Dairy Husbandry Adviser.
A. J. Quick.
Proceedings of Symposium: Farm Wastes: The Institute of Water Pollution Control and The University of Newcastle upon Tyne. 1970. Paper No 15, p 110-115. 1 tab, 6 ref.

Descriptors: *Farm wastes, *Disposal, *Effects, Slurries, Planning, Management, Dry farming, Storage, Equipment.
Identifiers: *Systems, *Comparison, Wash water, Wet farms.

This paper deals with the immediate problems facing the dairy farmer who finds himself in the economic squeeze, with the inevitable result that he will intensify his dairy enterprise. At the moment there is no universal solution to his problems, but they can be tackled, first by identifying the factors which will influence the choice of system (by factors are meant soil type, system of cow-housing, and unit size) and second, by selecting the most suitable system from the available alternatives.
(Christenbury-Iowa State)

0250 - B2, B3, E2

LAND DISPOSAL AND STORAGE OF FARM WASTES. 2. HANDLING AND DISTRIBUTION,
National Agricultural Advisory Service, London (England). National Livestock Mechanization Specialist.
J. I. Payne.
Proceedings of Symposium: Farm Wastes: The Institute of Water Pollution Control and The University of Newcastle upon Tyne. 1970. Paper No 16, p 116-121. 1 fig, 2 tab, 1 ref.

Descriptors: *Farm wastes, *Mechanical equipment, *Distribution, Slurries, Disposal, Treatment, Storage, Costs, Cattle, Irrigation.
Identifiers: *Handling, Removal, Solid manure, Organic irrigation.

The mechanization aspect of applying farm effluent to the land is governed by the physical state of the effluent, the stock housing system and the type of farm on which the stock enterprise is situated. Consequently three basic systems of handling manure onto the land have evolved. These are handling it as a solid manure, as a dense slurry, and as a diluted slurry. This paper discusses the equipment required for each of the handling systems. In general, if the manure can be kept solid the problems will be fewer. (Christenbury-Iowa State)

0251 - C1, D4

AEROBIC TREATMENT OF FARM WASTES,
North of Scotland Coll. of Agriculture, Aberdeen. Scottish Farm Buildings Investigation Unit.
K. Robinson, S. H. Baxter, and J. R. Saxon.
Proceedings of Symposium: Farm Wastes: The Institute of Water Pollution Control and The University of Newcastle upon Tyne. 1970. Paper No. 17, p. 122-131. 1 tab, 9 fig, 26 ref.

Descriptors: *Aeration, *Mechanical equipment, *Aerobic treatment, Farm wastes, Odor, Slurries, Ventilation, Farm lagoons, Biochemical oxygen demand, Hogs, Chemical oxygen demand, Microorganisms, Dissolved oxygen, Laboratory tests, Waste water treatment.
Identifiers: Oxidation ditch, Aeration lagoon.

This paper is divided into two main sections - a review of existing commercially available methods of aerobic waste disposal and an outline of the project in Aberdeen for the study of pig-waste treatment. The review is limited to a description of aerobic methods and no specific attempt has been made to compare the relative merits of these systems, since a critical examination of some of them is one of the aims of our project. The characteristics of pig waste, its oxygen demands, and the influences of copper on bactorial activity are discussed. The factors influencing the growth and metabolic activity of micro-organisms are outlined and the problems of satisfactory methods of laboratory determinations are emphasized.
(Christenbury-Iowa State)

0252 - D4, E4

ANAEROBIC TREATMENT OF FARM WASTES,
West of Scotland Agricultural Coll., Glasgow. Dept. of Bacteriology.
Selwyn Baines.
Proceedings of Symposium: Farm Wastes: The Institute of Water Pollution Control and The University of Newcastle upon Tyne. 1970. Paper No. 18, p 132-137. 1 tab, 20 ref.

Descriptors: *Farm wastes, *Anaerobic digestion, Anaerobic conditions, Anaerobic bacteria, Microorganisms, Sludge, Slurries, Mixing, Hydrogen ion concentration, Biochemical oxygen demand, Digestion, Design data, Methane, Waste water treatment.
Identifiers: Commercial applications, Gas production.

This paper describes the effects of anaerobic treatment and its application to farm wastes. A satisfactory methane fermentation can be established and maintained. The digested sludge is relatively inert, free from nuisance and more amendable to dewatering. The anaerobic digestion process also reduces the risk of pathogenic organisms causing human or animal diseases. The design and operation of an anaerobic treatment process is described. Several reports from commercial installations are included. (Christenbury- Iowa State)

0253 - D4, F1

TREATMENT OF FARM WASTES,
Instituut voor Landbouwbedrijfsgebouwen, Wageningen (Netherlands).
H. M. J. Scheltinga, and H. R. Poelma.
Proceedings of Symposium: Farm Wastes: The Institute of Water Pollution Control and The University of Newcastle upon Tyne. 1970. Paper No 19, p 138-142. 3 tab, 3 fig.

Descriptors: *Farm wastes, *Biological treatment, *Aerobic treatment, Farm lagoon, Activated sludge, Aeration, Slurries, Biochemical oxygen demand, Sludge, Cost comparison, Waste water treatment.
Identifiers: Oxidation ditch, Pasveer ditch.

This paper is related to biological treatment of farm animal waste. Aerobic treatment is described. A schematic of an oxidation ditch and an aeration pit is included. The economic aspect of the oxidation ditch versus the aeration pit is presented. A discussion of the paper is included.
(Christenbury-Iowa State)

0254 - D4, E3

AEROBIC STABILIZATION OF BEEF FEEDLOT WASTE,
Texas Tech Univ., Lubbock.
W. Grub, J. D. Martin, and L. L. Keeton.
Paper presented at the 1970 winter meeting American Society of Agricultural Engineers, Chicago, December 8-11, 1970, Paper No 70-909. 6 p.

Descriptors: *Anaerobic digestion, *Biological treatment, Farm wastes, Moisture content, Aerobic conditions, Oxygen requirements, Stabilization, Nitrogen, Waste water treatment.
Identifiers: *Composting, *Carbon to nitrogen ratio (C/N), Housefly.

Solid waste that had accumulated on Southwestern beef cattle feedlots was aerobically stabilized under controlled conditions in enclosed digesters and in open air piles. Conditions for stabilization were determined and changes of physical, chemical and biological characteristics were established. The organic stabilization of beef feedlot waste by composting is a feasible process. Organic beef feedlot waste is compostable in specially designed digesters or in exposed open air piles, to a biologically stable organic product, free from noxious odors and inset infestation. Stabilized waste can be stored in a wet or dry state without danger of heating, attracting insects, or causing noxious odors. The time of stabilization depends on the type of original feed material, the condition of the waste at the start of the composting period, and the management of the composting process. Composting requires skilled management to obtain satisfactory results.
(Christenbury-Iowa State)

0255 - A2, B3

EFFECTS OF MANURE DEPTH ON RUNOFF FROM SOUTHWESTERN CATTLE FEEDLOTS,
Texas Tech Univ., Lubbock.
L. L. Keeton, W. Grub, D. M. Wells, G. F. Meenaghan, and R. C. Albin.
Paper presented at the 1970 winter meeting American Society Agricultural Engineers, Chicago, December 8-11, 1970, Paper No 70-910. 7 p, 2 tab, 1 ref.

Descriptors: *Rainfall intensity, *Rainfall-runoff relationships, Farm wastes, Pollutants, Moisture content, Biochemical oxygen demand, Chemical oxygen demand, Waste water treatment, Water pollution sources.
Identifiers: Feedlot runoff, Feedlot slope, Water holding capacity

With the increasing number of beef cattle in feedlots in the Southwestern United States has come a major water pollution problem. The effects of manure accumulation on quantity and quality of runoff from concrete and direct surfaced feedlots for various precipitation rates were determined. A relatively dry manure pack holds approximately one-half inch of rainfall per inch of manure depth. If runoff from a relatively dry mass occurs, large quantities of suspended and dissolved pollutants are carried off. Manure at 60 percent moisture minimizes the pollutants removed during feedlot runoff. The quality of feedlot runoff is primarily a function of the moisture content of the manure, the rainfall intensity, and the feedlot slope. (Christenbury-Iowa State)

0256 - E1, F1

USE ANIMAL MANURE EFFECTIVELY,
Arizona Agricultural Experiment Station, Tucson.
J. L. Abbott.
Agricultural Experiment Station and Cooperative Extension Service Bulletin A-55, The University of Arizona. 3 tab, 1 fig, 6 ref.

Descriptors: *Farm wastes, *Fertilizers, *Rates of application, *Return (Monetary), *Beneficial use, Livestock, Arizona, Feedlots, Disposal, Costs, Salts, Nitrogen, Organic matter, Waste treatment.
Identifiers: Manure, Composting.

This publication discusses some important considerations that should be taken into account concerning the use of animal manure as a fertilizer. A possible $90-per-acre return for a $20-per-acre investment is being overlooked by many Arizona farmers. The cost of applying manure is in the order of $2 to $14 per ton up to a 40 mile haul. The fertilizer value of manure is at least $2 per tone for available N and P. The value of organic matter must account for the balance in cost. The greatest value of manure may result from the indirect effects of the organic matter contribution on the physical condition of the soil and in maintaining the availability of certain soil nutrients. The soluble salts in manure commonly range from 5 to 10 percent on a dry basis. Recommendations for manure are seldom more than 5 tons per acre annually.
(Christenbury-Iowa State)

0257 - C5

DRINKING OF SULFATE-WATER BY CATTLE,
Nevada Univ., Reno.
H. J. Weeth, and J. E. Hunter.
Journal Paper No 168. Journal of Animal Science, Vol 32, No 2, p 277-281, 1971. 1 tab, 39 ref. West Reg Research Project W-46.

Descriptors: *Sulfates, *Sodium chloride, Farm wastes, Cattle, Toxicity, Water, Growth rates, Water pollution effects.
Identifiers: *Drinking water, Sulfate water, Hemoglobin.

This study was designed to characterize some of the effects on cattle of drinking water contaminated with a known concentration of sulfate. Nine growing Hereford heifers were offered as drinking water either tap-water, 5,000 ppm Na sub 2 SO sub 4-water or 4,110 ppm NaCl-water. The experimental design was a 3x3 latin square with replicates. Experimental periods were 30 days. Total urine was collected on the last 7 days with renal clearance observations being made on the sixth day. The season was summer. The heifers drank less, ate less and lost weight while consuming the sulfate-water. The sulfate ion caused a relative diuresis. Percent urine water of free-water intake was 33.8 with sulfate-water, but only 22.1% with tap water. Total hemoglobin concentration was unaffected by the saline drinking waters, however, the sulfate-water caused a 450% increase in methemoglobin concentration and the development of 416.9 mg/100 ml of sulfhemoglobin. The two nonfunctional hemoglobins comprise 6.2% of total hemoglobin at this time. Drinking the sulfate-water increased serum sulfate concentration 63.1%, increased renal filtration of sulfate 45.2%, but decreased renal reabsorption of sulfate by 27.5%. Drinking sulfate-water did not alter plasma calcium concentration or renal excretion of calcium. A specific toxic effect of drinking the Na sub 2 SO sub 4-water was not apparent, however, the adverse effects seen were related to the sulfate ion. Only a slight polyposia and diuresis were observed with drinking of the NaCl-water. (Christenbury-Iowa State)

0258 - E4

GAS PRODUCTION FROM BEEF CATTLE WASTES,
Texas Tech Univ., Lubbock.
G. F. Meenaghan, D. M. Wells, R. C. Albin, and W. Grub.
Paper presented at the 1970 winter meeting American Society of Agricultural Engineers, Chicago, December 8-11, 1970, Paper No 70-907. 15 p, 9 fig.

Descriptors: *Anaerobic digestion, *Gases, Farm wastes, Chemical oxygen demand, Cattle, Carbon, Nitrogen, Hydrogen, Alkalinity, Methane, Biochemical oxygen demand, Waste treatment, Air pollution, Pollution abatement.
Identifiers: *Composting, *Gas production, Carbon to nitrogen ratio (C/N), Beef cattle, Carbonaceous material, Volatile acids.

A two-stage completely mixed isothermal digestion system having a capacity of 30 gallons/stage was fed wastes from a beef cattle controlled environment chamber. Gas production was monitored and analyzed by a wet test meter and a gas chromatograph, respectively. Physical and bio-chemical tests were also performed. This study indicates that a completely mixed, two stage anaerobic digestion system is technically feasible and can be used for obtaining nominal treatment of beef cattle wastes. Even with optimal conditions per stage such a system will not be sufficient for complete treatment. (Christenbury-Iowa State)

0259 - A1, C1, D1, F4

ANIMAL WASTES - A NATIONAL PROBLEM,
Cornell Univ., Ithaca. Dept. of Agriculture; and Cornell Univ., Ithaca. Dept. of Civil Engineering.
Raymond C. Loehr.
Proceedings of the American Society of Civil Engineers, Journal of the Sanitary Engineering Division, Vol 95, No SA2. 9 tab, 4 fig, 86 ref.

Descriptors: *Farm wastes, *Anaerobic digestion, *Aerobic treatment, Dehydration, Environment, Cattle, Hogs, Poultry, Sheep, Diets, Odors, Ruminants, Weight, Nitrogen, Phosphorus, Potassium, Waste water treatment, Confinement pens, Digestion, Proteins, Moisture content, Physical properties, Density, Chemical properties, *Water pollution sources, Waste dilution, Slurries, Biochemical oxygen demand, Runoff, Ammonia, Chemical oxygen demand, Oxygen demand, Nitrates, Surface waters, Effluents, Coliforms, Incineration, Aeration, Farm lagoons.
Identifiers: *Animal production, *Population equivalents, Fiber content, Manure production, Nuisance potential, Feedlots, Oxidation ditch, Slatted floors.

A state of the art summary is presented on the control and management of animal wastes. Items discussed include the magnitude of the problem, pollution that has been caused by animal wastes, feasible treatment processes, major problem areas, and areas for future activity. Animal production and their subsequent waste production, properties, and characteristics are discussed first. The pollution and nuisance potential is then pointed out with respect to population equivalents. Waste treatment and disposal processes and systems follow. A summary and conclusion point out problems and what direction should be taken in the future. The paper was 86 references. (White-Iowa State)

0260 - C4, E3

GROWTH OF MICROORGANISMS IN FRESH CHICKEN MANURE UNDER AEROBIC AND ANAEROBIC CONDITIONS,
Kentucky Univ., Lexington. Dept. of Agricultural Engineering, and Kentucky Univ., Lexington. Dept. of Animal Science.
Sully W. Jackson, B. E. Langlois, and T. H. Johnson.
Poultry Science, Vol 49, No 6, 1970, p 1749-1750. 1 fig, 5 ref.

Descriptors: *Feeds, *Farm wastes, Poultry, *Aerobic conditions, Bacteria, Microorganisms, Laboratory tests, *Anaerobic conditions, Disposal.
Identifiers: Waste re-use, Uric acid, Ruminant feeds.

Utilization of animal manure as feed not only would provide a new source of protein for animals, but also would help to reduce the pollution of the environment. While use of such material as feed is not permitted at this time, research is necessary in order to determine the feasibility of using manure as feed in the event it is made legal. This study was made to determine whether microorganisms contained in chicken manure could utilize constituents of the fresh manure and increase in number during aerobic or anaerobic fermentation. Results suggested that fresh chicken manure contains substrates capable of supporting aerobic but not anaerobic growth of bacteria. (Hazen-Iowa State University)

0261 - D4

ANAEROBIC DIGESTION OF FARM ANIMAL WASTES (DAIRY BULL, SWINE AND POULTRY),
Wisconsin Univ., Madison. Dept. of Civil Engineering, and Wisconsin Univ, Madison. Dept. of Agricultural Engineering.
Lorne C. Gramms, L. B. Polkowski, and Stanley A. Witzel.
Transactions of the ASAE, Vol 14, No 1, January-February 1971, p 7-11, 13. 10 fig, 4 tab, 7 ref.

Descriptors: *Anaerobic digestion, *Farm wastes, *Digestion, Laboratory tests, Sludge, *Chemical Oxygen Demand, Poultry, Cattle, Gases, Hydrogen ion concentration, Alkalinity, Settling velocity.
Identifiers: Volatile solids reduction, Gas production, Volatile acids, Dentition time.

Dairy bull, swine, and pultry wastes are amenable to anaerobic digestion. Anaerobic digests for dairy bull waste may be loaded at rates of 0.24 pound VS per cubic foot per day with detention times between 10 to 15 days for good reduction in volatile solids and COD. Anaerobic digesters for pultry waste should not be loaded at rates greater than 0.18 pound VS per cubic foot per day with detention times between 10 to 15 days. Although substantial reductions may be achieved in volatile solids, and COD, the ultimate disposal of the wastes would still be a problem. If long term anaerobic digestion were used it would allow storage until the sludge could be spread on the land to obtain the optimum fertilizer value for land management. Of the three wastes studied the specific resistance of the poultry waste was the only value that was similar to the specific resistance of anaerobically digested domestic sludge. (Hazen-Iowa State University)

0262 - A5, B1

WASTE HANDLING: WHAT ARE THE CHOICES,
Wisconsin Univ., Madison. Dept. of Agricultural Engineering.
O. I. Berge.
Hoard's Dairyman, Vol 116, March 25, 1971, p 353, 383. 1 fig.

Descriptors: *Farm wastes, *Waste water treatment, Waste disposal, Waste storage, Cattle, Odor, Fertilizers, Value.
Identifiers: *Waste handling, Waste utilization.

Waste disposal has long been a problem. Wastes must be removed periodically for good sanitation. For dairymen, the three major alternatives for handling manure are daily spreading, stockpiling for spreading when field conditions are more favorable, and liquid storage with spreading under more desirable conditions. All three systems depend on the availability of land for spreading within a reasonable distance of the cattle barn. No system of manure handling has been devised which is not likely to offend the nostrils of sensitive people. (Hazen-Iowa State University)

0263 - D4

REMOVAL OF PLANT NUTRIENTS BY MEANS OF AEROBIC STABILIZATION OF SLUDGE,
Illinois Univ., Urbana. Dept. of Microbiology; and Illinois Univ, Urbana. Dept. of Agricultural Engineering.
Roar L. Irgens, and H. Orin Halvorson.
Applied Microbiology, Vol 13, No 3, May 1965, p 373-386. 16 fig, 8 tab, 8 ref.

Descriptors: Chemical Oxygen Demand, *Biochemical Oxygen Demand, *Waste water treatment, *Sludge treatment, Sludge digestion, Denitrification, *Nutrients.
Identifiers: Digester supernatant fluid, Kjeldahl nitrogen.

In the convential treatment of sewage, the solids are normally disposed of by anaerobic digestion. This leaves a considerable amount of plant nutrients, such as nitrogen and phosphate, as soluble compounds which will eventually find their way into the plant's final effluent, since the supernatant fluid from the digesters is normally returned to the raw sewage. In a recent investigation, we found that, if the sludges were treated by an aerobic process, a significant portion of the carbonaceous matter was oxidized to carbon dioxide and water, and the rest was assimilated into microbial protoplasm. This process tied up the available nitrogen and phosphorus so that practically none remained dissolved in the suspending liquid. The accumulated solids, consisting mostly of microbial cells were separated very easily from the liquid leaving a slightly colored supernatant fluid that was water-clear, free from plant nutrients, and very low in BOD and COD. The overall process was accomplished in a detention time not exceeding 20 days, in contrast to anaerobic digestion which requires from 50 to 70 days. (Hazen-Iowa State University)

0264 - B2

HANDLING METHODS FOR LIQUID MANURE ARE TESTED,
D. W. Bates.
Hoard's Dairyman, Vol. 116, p 273, March 10, 1971, 3 fig.

Descriptors: *Waste disposal, Waste dumps, *Farm wastes, *Cattle, Storage tank, *Waste storage, Liquid wastes.
Identifiers: Barn heat.

Methods for handling liquid manure stored in a large external tank over an extended period of time were evaluated. The 150,000 gallon storage tank was constructed at a right angle to the end of a 60-cow tie stall barn. A cover of woven wire, polyethylene and baled straw was used in winter; the tank was uncovered in the summer. No conveyor system was installed. Waste heat from the barn's ventilation system was exhausted into the tank to prevent or reduce freezing. Pumps were used to level and remove the tank's contents. Conclusions are: (1) Manure stored in a large tank can be agitated and removed without difficulty under proper management; (2) Manure deposited in one end of a long tank will distribute itself sufficiently under its own weight so a conveyor is not necessary; (3) Waste heat from a barn's ventilation system is valuable in preventing freezing in an exposed manure storage tank. (Hazen-Iowa State)

0265 - B1, C5

PENICILLIN BY THE POUND,
Margaret E. Duffy.
Environment, Vol 11, No 8, 1969, p 14-21. 2 fig, 40 ref.

Descriptors: *Animal pathology, Disease resistance, *Diseases, Farm wastes, Beneficial use, Poultry, Regulation, Feeds, Cattle.
Identifiers: *Antibiotics, Agricultural uses, Growth promotion, Disease prevention, Hormones, *Penicillin, Drugs, Side effects, Therapeutic value, Hemorrhages, FDA.

Antibiotics, hormones and many other medicines used to treat human sickness have found their way into agriculture. The drugs are used to treat animal diseases, to promote growth, to preserve food and to protect plants. Far more antibiotics are used on farms than in hospitals, and the growing reliance on these and other medicines in agriculture raises a host of problems. The most serious of these may be the appearance of resistance in microbes to antibiotic treatment. Most of the antibiotics used in agriculture are added to the feed of cattle, pigs, chickens and lambs in order to promote growth. Antibiotics have had a greater effect on chickens and pigs raised in a previously occupied and therefore unsanitary environment than those raised in sanitized or new quarters. Prolonged feeding with antibiotics has more than once been reported to result in a decreased growth response in chicks. Antibiotics do not promote growth in germ-free animals. Some of the harmful side effects are: allergic and toxic effects of drugs, alterations in microbial flora which can cause disease and the development of resistant strains of micro-organisms. Animals may accumulate antibiotics in blood and muscle tissue when given antibiotics in their feed. Hence, antibiotics may find their way into meat products if animals are slaughtered before antibiotic residues have disappeared. (Hazen-Iowa State University)

0266 - A5, B2, C5

CAGED LAYER PERFORMANCE IN PENS WITH OXIDATION DITCHES AND LIQUID MANURE STORAGE TANKS,
Guelph Univ. (Ontario). Dept. of Poultry Science.
J. P. Walker, H. L. Orr, and J. Poe.
Poultry Science, Vol 50, No 2, March 1971, p 501-505. 1 tab, 4 ref.

Descriptors: *Poultry, *Oxidation lagoons, *Confinement pens, *Performance, Waste disposal, Farm wastes, Waste treatment, Storage tanks, Slurries, Aeration, Equipment, Nitrogen, Odor, Design criteria.
Identifiers: Liquid manure, Egg production, Egg quality, Anti-foaming agent.

The increased size of poultry operations and the spread of urban areas has created problems in the disposal or utilization of poultry waste. These have been aggravated by the increased use of the liquid system of manure handling and its resultant odors. The purpose of this study was to evaluate the performance of caged layers housed in a pen utilizing oxidation ditches in contrast to caged layers housed in a pen with anaerobic liquid storage tanks. The conclusion is that hen housed egg production, egg quality, feed conversion and mortality performance of caged layers in pens with oxidation ditches was similar to that of caged layers in pens with liquid manure storage tanks. The odor in the pen with the oxidation ditches was less offensive than in pens with anaerobic liquid manure tanks. Modifications must be developed for oxidation ditches or other more economical means developed for oxidizing liquid poultry manure before it has practical application. (Hazen-Iowa State University)

0267 - F1

WASTE MANAGEMENT...WHAT DOES IT COST,
Wisconsin Univ., Madison. Dept. of Agricultural Engineering.
Orrin I. Berge.
Hoard's Dairyman, Vol 116, April 10, 1971, p 420. 8 tab.

Descriptors: *Waste disposal, *Cost comparisons, *Farm wastes, Cattle, *Costs, Cost analysis, Annual costs, Capital investment, Fertilizers, Value.
Identifiers: Cost factors.

This article is an economic protection of the cost factors involved in handling wastes by daily hauling, stacking or liquid manure. Daily hauling requires the least investment and liquid manure systems the most. The annual costs for each of the systems are much closer than the investment figures. The cost of the waste handling systems may be offset to a considerable extent by the fertility value of the wastes. (Hazen-Iowa State University)

0268 - B3

MANURE STACKING.
Hoard's Dairyman, Vol 115, October 1970, p 1028, 1067. 3 fig.

Descriptors: *Waste disposal, *Waste dumps, *Waste storage, *Farm wastes, Management, Equipment.
Identifiers: Waste storage facilities.

The expense and problems involved with hauling wastes daily and the cost of liquid waste systems have caused agricultural engineers and dairy farmers to consider other ways of handling farm wastes, one of which is stacking. Unlike liquid waste systems, the amount of water that is mixed with the manure must be kept to a minimum. Another problem that may result with stacking is that of runoff from the stack itself. There is not the odor problem that exists in liquid systems. There are a number of stackers on the market; as it appears more dairymen will switch to stacking as a disposal system. (Hazen-Iowa State University)

0270 - A8, C4

RAPID CONCENTRATION OF STRONGYLE EGGS FROM EQUINE FECES FOR IN VITRO STUDIES,
Louisiana State Univ., Baton Rouge. Dept. of Veterinary Science.
Thomas R. Bello, and Virginia L. Gordon.
American Journal of Veterinary Research, Vol 31, No 12, p 2285-2288, December, 1970, 1 tab, 7 ref.

Descriptors: *Farm wastes, Laboratory tests, Nematodes, Eggs, *Separation techniques, Pollutant identification.
Identifiers: Equine, Horse, Laboratory procedures, *Strongyle eggs.

For in vitro studies, large numbers of strongyle eggs in equine feces were suspended, sieved, sedimented in water, and then floated in sucrose solution by centrifugation. The eggs were prepared for cultures by disinfecting with 1.2 to 1.3% sodium hypocholorite solution and washing in sterile Tyrode's solution containing antibiotics. This rapid concentration technique was 100.2 .. 2.2% efficacious based on eggs-per-gram (e.p.g.) fecal counts from 20 horses. (Christenbury-Iowa State)

0271 - E3

GROWING CORN IN GROWTH CHAMBERS WITH DIFFERENT MANURE TREATMENTS,
Kansas State Univ., Manhattan. Dept. of Agricultural Engineering.
Eugene Goering, R. I. Lipper, and H. L. Manges.
Unpublished Paper, Presented 1971 Mid-Central Meeting American Society of Agricultural Engineers, Paper No MC-71-104, 17 p, 10 tab, 6 ref.

Descriptors: *Farm wastes, *Crop response, Disposal, Laboratory tests, Plant tissues, Growth chambers, Cattle.
Identifiers: Manure, Application rates, Contamination.

The purpose of this experiment was to determine the effect on corn germination and early growth of different manure loading rates and to compare the effect of planting in manure mixed with soil against placement of seed above a manure layer. Germination and early growth of corn in plant growth chambers were adversely affected by applications of beef feedlot manure at rates ranging from 35 to 175 tons/acre, oven dry basis. The effects were different when manure was completely mixed with soil than when applied as a layer under a soil cover. (Christenbury-Iowa State)

0272 - E2, E3

A DOSING SIPHON FOR DISCHARGING CLEANING WATER INTO FLUSHING GUTTERS,
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
H. L. Person, and J. R. Miner.
Unpublished paper presented at the 1971 Mid-Central Region Meeting American Society of Agricultural Engineers. Paper No MC-71-105, 22 p, 10 fig, 3 ref.

Descriptors: *Farm wastes, Design data, Equipment, Confinement pens, Test procedures, Theoretical analysis, Water pollution control.
Identifiers: *Flushing gutter, *Dosing siphon, Waste removal, Snifter.

An automatic dosing siphon has been designed, built, and used for discharging water into flushing gutters. An explanation of how the device operates as well as test data and design information are presented. The automatic dosing siphon is easy to design and build. The parts are commercially available. If proper precautions are taken to ensure that all joints are airtight, the automatic dosing siphon is a dependable device for discharging cleaning water into flushing gutters. (Christenburg-Iowa State)

0273 - C3, C5

ROLE OF EXCRETED CHLORTETRACYCLINE IN MODIFYING THE DECOMPOSITION PROCESS IN FEEDLOT WASTE,
Colorado State Univ., Ft. Collins. Dept. of Microbiology.
G. Keith Elmund, S. M. Morrison, D. W. Grant, and M. P. Nevins, Sr.
Bulletin of Environmental Contamination and Toxicology, Vol 6, No 2, 1971, p 129-131.

Descriptors: *Farm wastes, Biodegradation, *Biochemical oxygen demand, Bactericides, Toxicity, *Stabilization, Bioassay, Biological treatment, Diets, Water pollution effects, Feeds, Cattle, Ruminants, Pollutant identification.
Identifiers: Feedlot wastes, Dietary antibiotic, Rumen microflora, *Chlortetracycline.

Quantitative bioassays of fresh feedlot manure revealed that approximately 75 percent of the dietary chlortetracycline was excreted. The antibiotic concentration was 14 microgram g/gm of fresh feedlot manure, and 0.34 microgram g/gm of aged feedlot manure. Standard BOD5 values on manure from control steers and manures from steers receiving dietary chlortetracycline demonstrated that antibiotic supplementation of animal feeds may alter the microflora participating in the stabilization of feedlot manure. The effect of ingested chlortetracycline is two fold: (1) ingested antibiotic selects for a microbial population relatively inefficient in the stabilization process and (2) antibiotic supplementation apparently alters the digestive processes in the animal, resulting in manures which are less biodegradable as measured by the standard BOD5 procedure. (Christenburg-Iowa State)

0274 - F4

POLLUTION, PESTICIDES AND THE PEOPLE - – AGRICULTURE AND OUR NATURAL ENVIRONMENT.
Greater Des Moines Chamber of Commerce, Iowa. Agricultural Dept.

33rd Annual (Forum), National Farm Institute, February 11-12, 1971, Des Moines, Iowa, 107 p.

Descriptors: *Farm wastes, *Pesticides, *Sediment, *Water pollution effects, Fertilizers, Economics, Legislation, Water pollution control, benefits, Costs, Agriculture standards, Water quality, Taxes, DDT, Population, Livestock, Environment, Sewage.
Identifiers: Conservancy districts.

The proceedings of the National Farm Institute include papers concerned with the various aspects of pollution and today's environment. Various pollutants which are discussed include farm wastes, fertilizers, pesticides, and sediment. In addition, other papers report on population aspects, legislation, economics of pollution control, and interest groups concerned with pollution. A wide array of views and potential control systems are examined (White-Iowa State)

0275 - A3, F3

THE CITIZENS' VIEW OF POLLUTION,
League of Women Voters of the United States, Washington, D.C. Environmental Quality Program.
Donald Clusen, Mrs.
In: 33rd Annual Forum, National Farm Institute, February 1971, Des Moines, Iowa, p 7-13.

Descriptors: *Environment, *Water pollution effects, Pollution abatement, Legislation, Governments, Research and development, Water quality, Standards, Water Quality Act, Taxes, Agriculture.

The author attempts to give societies view of pollution while admitting that the role of spokesman is a dangerous one. Trying to describe pollution or what it is constitutes a problem as varied as trying to prescribe solutions. There is no national consensus on environmental questions unless it is that a problem exists and the time to deal with it is now. An aroused public must insist that more be done, and faster, to abate pollution. Equally important is the preparation of a number of alternatives. Water resource development must be viewed as an integral part of the national effort to protect and improve the quality of man's environment. The general public has demonstrated that they want their money spent for pollution abatement. People want to have a voice in the choices to be made, they want to see some progress made, and they want environmental concerns to have a higher priority - in government, business and agriculture. (White-Iowa State)

0276 - A3, A7

THE SPORTSMAN'S VIEW,
National Wildlife Federation.
Phillip Douglas.
In: 33rd Annual Forum, National Farm Institute, February 1971, Des Moines, Iowa, p 15-22.

Descriptors: *Pesticides, *DDT, Water pollution effects, Conservation, Biodegradation, Recreation, Diseases, Beneficial use, Toxicity, Solubility, Fish, Birds, Biocontrol, Cultural control.
Identifiers: *Biological concentration, Primary effects, Secondary effects.

Both sides of the pesticide problem are presented in this paper. Pesticides, and in particular DDT, have been used successfully to help control typhus fever, malaria, and dutch elm disease among others. These beneficial effects are sometimes offset by their harmful residues. The DDT molecule combines four properties that are responsible for its behavior in the environment: (1) toxicity to almost all animal life; (2) persistence; (3) mobility; and (4) solubility properties. Many examples of fish and bird fatality are pointed out as the result of the accumulation of DDT. Ususally these are the higher animals in carnivorous food chains. Twelve steps or courses of action are recommended to help alleviate the problem. (White-Iowa State)

0277 - A7

THE FARMERS' CONCERN,
Gilbert Staneck.
In: 33rd Annual Forum, National Farm Institute, February 1971, Des Moines, Iowa, p 23-29.

Descriptors: *Wastes, *Water pollution effects, Dieldrin, DDT, Mercury, Pesticides, Insecticides, Herbicides, Resistance, Research and development, Education, Regulation.
Identifiers: *Panic power, Mis-use, Tolerance level.

Farmers have four areas of concern in the environmental pollution field. The first is 'panic power' created by news media and other sources that cry out in unsure, uninformed voices about the uncertainties of pollution. The second area is mis-use or the improper handling of wastes and pesticides by farmers as well as non-farmers. The third area deals with tolerance levels. What criteria should be used and what levels should be set are questions which remain largely unanswered. The fourth area of concern to farmers is that they are a minority group. We are warned that if the American farmers' efficiency of production is jeopardized by banning of pesticide usage, the consumer will suffer through increased food prices because of reduced production. Research, education and regulation are key steps to preserve our standard of living. (White-Iowa State)

0278 - A1

POPULATION GROWTH RATE SHOULDN'T GET ALL THE BLAME,
Bureau of the Census, Washington, D.C.
Conrad Taeuber.
In: 33rd Annual Forum, National Farm Institute, February 1971, Des Moines, Iowa, p 31-39.

Descriptors: *Human population, *Growth rates, Fertility, Fecundity, Census, Cities, Water pollution effects, Natural resources.

Population growth characteristics of the United States are pointed out. The growth rate is traced from pre-war times to present, with projections being made for future growth. Pollution and other social ills are not primarily a result of our rate of population growth. Changing standards and habits, in activities, technology, and the style of life have much more to do with the accumulation and disposition of waste materials and pollutants than does the number of persons involved. (White-Iowa State)

0279 - A3, A4, A9

POLLUTION - HOW MUCH OF A PROBLEM COMES FROM FERTILIZERS,
Missouri Univ., Columbia. Water Resources Research Center.
George E. Smith.
In: 33rd Annual (Forum), National Farm Institue, February 1971, Des Moines, Iowa p. 40-48.

Descriptors: *Fertilizers, *Nitrogen, *Nitrate, Nitrite, Nutrients, Fertility, Toxicity, Eutrophication, Phosphorus, Water supply, Water wells, Runoff, Carbon dioxide, Oxygen, Photosynthesis, Water pollution, Soil contamination.
Identifiers: Metoglobenemia, Nitrate accumulation.

An objective view is given of fertilizer usage and its role as a pollutant. First concern for pollution from fertilizers was in connection with nitrate toxicity (metoglobenemia) in human infants and some species of livestock. Most of the water involved came from improperly constructed wells near livestock or where low rainfall caused nitrate accumulation in the soil from organic matters. Chemical fertilizers as well as city sewage, livestock wastes, and plant residues are all sources of nutrients which may cause eutrophication. Nitrate may accumulate in plant tissue to undesirable levels only under certain climatic and cultural conditions. A Missouri study of water supplies indicated that most nitrate contaminated wells were (1) in rural locations, (2) shallow, (3) poorly constructed, and (4) in areas where livestock production is the main source of farm income. There was a high degree of correlation between the occurrance and the concentration of nitrate in these wells and their proximity to livestock feeding areas or to septic tank tile fields. A final note is made of the corn farmer as an ecologist, whereby an acre of corn will use 10.5 tons of CO2 while producing 2.5 tons of plant material and 8 tons of oxygen - enough to support 12 people for a year. (White-Iowa State)

0280 - A7

PESTICIDES,
Environmental Protection Agency, Washington, D.C. Pesticide Advisory Committee,
William M. Upholt.
In: 33rd Annual Forum, National Farm Institute, February 1971, Des Moines, Iowa p 49-56.

Descriptors: *Pesticides, *DDT, Diseases, Insecticides, Public health, Toxicity, Pesticide residue, Hazards, Poisons, Beneficial use, Water pollution effects.
Identifiers: *Parathion, Malaria, Cancer.

Pesticides are discussed with three main areas of emphasis. DDT is used as an example, but the principles are intended to apply to pesticides generally. The first area of emphasis is of the beneficial use of DDT. Increased production and the control of malaria are two main benefits. Human health hazards from pesticides are next pointed out. Death and illness have been attributed to pesticide poisoning. Currently the human health hazard that is most controversial is the possibility of cancer or birth defects from exposure to pesticide concentrations. Environmental hazards are the last area of concern. Biological accumulation and persistence in the environment are two main problems. The author suggest a drastic reduction in the use of DDT as one solution. Pesticides are useful, but they all carry some risk of damage to man or the environment. (White-Iowa State)

0281 - A1, C1, D1, E1, F4

LIVESTOCK WASTE,
Ohio State Univ., Columbus. Dept. of Agricultural Engineering.
E. Paul Taiganides.
In: 33rd Annual Forum, National Farm Institute, February 1971, Des Moines, Iowa, p 57-66, 1 tab.

Descriptors: *Farm wastes, *Cattle, Poultry, *By-products, Confinement pens, Water pollution effects, Odor, Organic matter, Moisture content, Runoff, Ammonia, Biochemical oxygen demand, Biological treatment, Drying.
Identifiers: *Animal production, *Coprology, Feedlots, Production efficiency, Waste properties, Population equivalent, Waste transport, Treatment processes.

A short comprehensive review is given of the changes in animal production and waste handling techniques. The transition from pasture to confinement production has met the demand for agricultural food and fiber. There has been a corresponding increase in animal waste management problems. This has given rise to what the author refers to as coprology - manure science. Current coprological technology includes knowledge of manure characteristics, transport methods, waste treatment and utilization schemes, and disposal media. Disposal must be done in such a way and at such a rate that nature will be able to assimilate it without creating environmental problems. (White-Iowa State)

0282 - A3

SEDIMENT: EVERYBODY'S POLLUTION PROBLEM,
Soil Conservation Service, Washington, D.C.
Kenneth E. Grant.
In: 33rd Annual Forum, National Farm Institute, February 1971, Des Moines, Iowa, p 67-76, 1 tab, 8 ref.

Descriptors: *Sediment, Water pollution effects, *Sedimentation, Agriculture, Soil erosion, Right-of-way, Soil, Farm waste, Water quality, Watersheds, Flood damage, Value, Benefits, Soil surveys, Research and development, Land management.
Identifiers: Nonfarm sources, Soil Conservation Service, Soil capability, Universal Soil Loss Equation, Wind Erosion Equation, Mulch tillage, Conservation Needs Inventory.

Sediment is the nation's largest pollutant. It is not only a pollutant in itself, but a carrier of animal wastes and chemical pollutants. Examples of the enormity of the sediment problem are cited. Nonfarm sources of sediment are a serious and growing problem. The fight against soil erosion has been headed by more than 3000 local soil and water conservation districts in the United States. A Conservation Needs Inventory indicates that 63% of all privately owned land (cropland, pasture, range, forest, other) needs some type of conservation treatment. Examples of the effectiveness of conservation treatment. Examples of the effectiveness of conservation measures are given. Continuing research and cooperation is needed between agencies and the general public in the resource conservation area. (White-Iowa State)

0283 - F1

ECONOMICS OF POLLUTION CONTROL,
Iowa State Univ., Ames. Dept. of Economics.
John F. Timmons.
In: 33rd Annual Forum, National Farm Institute, February 1971, Des Moines, Iowa, p 77-85.

Descriptors: *Environment, *Water pollution control, Economics, Natural resources, Standards, Programs, Costs, Benefits, Watersheds, Agriculture, Water pollution effects.
Identifiers: *Environmental quality, Goals, Quality standard, Suspended sediment, Production costs.

The paper suggests some ideas and methods that appear useful in understanding and in resolving some of the difficult but important issues emanating from three environmental quality questions. First, what are the standards of environmental quality that can serve as policy and program goals and at the same time engender wide spread and continuing public understanding and support. Next, what are the costs, both monetized and nonmonetized, of both achieving and failure to achieve the stated standards of environmental quality. Thirdly, who pays the costs both with and without achievement of the standards of environmental quality and who gets the benefits. Since environmental quality is a national issue, the author has endeavored to identify and elaborate upon these three major considerations in our quest for improvements in the quality of the natural environment. (White-Iowa State)

0284 - F1

CURRENT CONSERVANCY LEGISLATION,
Iowa House of Representatives, Des Moines.
Dale M. Cochran.
In: 33rd Annual Forum, National Farm Institute, February 1971, Des Moines, Iowa, p 87-93.

Descriptors: *Soil conservation, *Legislation, Wind erosion, Drainage, Soil erosion, Water pollution effects, Sediment, Rivers, Fertilizers, Pesticides, Agriculture, Iowa.
Identifiers: *Conservancy Districts, Des Moines River, District soil commissioners, Non-farm sources, US Department of Agriculture.

The scope and content of Iowa's Conservancy District bill is explained in this paper. The bill resulted after a review and study of drainage laws indicated that flood control, water pollution, recreation, soil erosion, and others were closely related. Conservation efforts have become rather static for a number of reasons, among them apathy, large operators, and shifts to continuous row crops. The Conservancy bill, as proposed, would regulate farm and nonfarm sources of erosion both by wind and water. The local soil conservation district commissioners would be in charge of soil conservation compliance. Cost sharing would be available for those required to comply. Failure to comply could result in a court order requiring immediate compliance and loss of any cost sharing funds that might have been available. (White- Iowa State)

0285 - F3

POLLUTION CONTROL DECISIONS - WHO SHOULD MAKE THEM,
Resources for the Future, Inc., Washington, D.C.
Edwin T. Haefele.
In: 33rd Annual Forum, National Farm Institute, February 1971, Des Moines, Iowa, p 95-99.

Descriptors: *Water pollution control, *Pollution abatement, Governments, Legislation, Environment, Taxes, Water pollution effects, *Decision making.
Identifiers: Individual rights, Executive responsibility.

Four lessons have been learned in the developing history of our country to the problems of pollution control. The first lesson is the necessity for legislative determination of policy. Most environmental issues are not problems that can be solved but conflicts that must be resolved. Individual rights is the second lesson. All of us are exercising our individual rights to the detriment of all of us. Rightfull use by each individual is the central core of the problem of over use of common property resources. The need for executive responsibility is the third lesson. The fourth lesson involves connecting the notion of individual right with that of personal interest through the use of taxation and prices as regulatory devices. (White-Iowa State)

0286 - A1, F4

AGRICULTURAL BENEFITS FROM URBAN POLLUTION CONTROL,
Office of the Secretary of the Army, Washington, D.C.
John R. Shaeffer.
In: 33rd Annual Forum, National Farm Institute, February 1971, Des Moines, Iowa, p 101-107.

Descriptors: *Water pollution control, *Sewage treatment, Sewage, Benefits, Agriculture, Environment, Pollutants, Water pollution effects, Pumping, Viruses, Diseases, Fertilizers, Irrigation, Michigan costs.
Identifiers: *Environmental vision, Waste management, Treatment cells.

An environmental 'vision' is needed which encompasses the fact that the environment is a single interacting closed system, and that pollutants are potential resources out of place. Utilizing these ideas, a pilot waste water management scheme for Muskegon County, Michigan is outlined. Sewage is first pumped to the surrounding countryside where treatment calls convert the waste to an odorless clear liquid by using all the forces of nature - air, aerobic bacteria, gravity, sunlight, and time. The liquid is then used as irrigation water and the soil removes the remaining nutrients, heavy metals, and viruses. An under drainage system picks up the pure water and brings it to a stream. For 42 million gallons of Muskegon County sewage a day, 10 thousand acres of land were needed. The costs for the new system are less than bringing the existing plants up to a secondary level of treatment. (White-Iowa State)

0287 - B1, E1

METHODS FOR DISPOSAL OF POULTRY MANURE,
New Zealand Dept. of Agriculture, Christchurch.
P. D. Thompson.
New Zealand Journal of Agriculture, Vol 116, No 1, January 1968, p 44-49. 2 tab, 5 fig.

Descriptors: *Poultry, Fertilizer, Oxidation lagoons, Irrigation efficiency, Solid waste drying, Market value, Weight, Chemical analysis, Larvae, Waste treatment, Waste disposal.
Identifiers: *Cage, Broiler, Sewage sludge, Indoor lagoon, Droppings, Offensive smell, Breeding ground.

The disposal of poultry manure in its various forms can cause problems by the spread of the urban settlement. Disposal of poultry manure should be divided into three stages: the collection of droppings; the removal of the droppings; and the disposal or processing. The volume of poultry manure per 1000 laying birds per week is approximately 32 cubic feet per ton with a moisture content of 70 per cent. Approximately fifty acres of grassland is required to dispose of the annual manure produced from 2500 deep litter layers or 20,000 broilers. Sludge disposal is another method of handling manure. To handle the manure from 1000 birds at a dilution of 1:1, a holding capacity of 10 to 18 cubic feet per day is required. Most of these storage tanks do not exceed 1000 cubic feet. The disposal by irrigation is one of the common practices of emptying these tanks. Still another method of disposal is the lagoon. A newer method of disposal is drying the manure. This method is expensive, and therefore requires a sure market to be practical. Poultry farmers should realize the many profitable alternatives for the disposal of manure. (Bundy-Iowa State)

0288 - E3

FIELD CROP IRRIGATION WITH OXIDATION POND EFFLUENT,
Mississippi State Univ., State College. Dept. of Agricultural and Biological Engineering; and Mississippi Agricultural and Forestry Experiment Station.
J. B. Allen, and J. C. McWhorter.
American Society of Agricultural Engineers, Paper No 71-246. 29 p, 10 tab, 8 fig, 12 ref. OWRR A-040-MISS (3).

Descriptors: *Oxidation lagoons, *Biochemical oxygen demands, Furrow irrigation, Rainfall, Wheat, Soybeans, Sudangrass, Clovers, Alfalfa, Mississippi crop yield, Nutrient requirements, Nitrogen, *Irrigation efficiency, *Water reuse.
Identifiers: Test plot, Coliform density.

The purpose of this 18-month study was to investigate the use of oxidation pond effluent for the irrigation of wheat, soybeans, sudax, alfalfa, and sweet clover in Mississippi. The study was conducted at the Agricultural and Biological Engineering Farm using effluent from a 2/3 acre oxidation pond located at the farm. All plots were furrow irrigated. Three irrigation treatments were used; irrigation with effluent, conventional irrigation, and no irrigation. A total of 23.8 inches of irrigation water was applied during the period from May 13, 1969 to October 29, 1970. The observed rainfall during this period was 81.95 inches, and the total of rainfall plus irrigation was 105.8 inches. At various times during the first growing season, samples of the effluent from the oxidation pond, the ground water beneath the plots, and stream flow from nearly sampling locations were collected for bacteriological and chemical analysis. The yield responses to both types of irrigation were small, probably because of a high ground water table at the plot location. There were no large yield responses resulting from the nutrients contained in the oxidation pond effluent. These nutrients were not sufficient to maintain a high level of crop production. (Bundy-Iowa State)

0289 - D3, F3

TREATMENT OF LONG ISLAND DUCK FARM WASTES,
Cornell Univ., Ithaca, N.Y. Dept. of Sanitary Engineering.
Charles D. Gates.
Journal Water Pollution Control Federation, Vol 35, No 12, December 1963, p 1569-1579. 7 fig, 2 tab, 16 ref.

Descriptors: *Ducks, *Chlorine, *Coliforms, *Water management, *Chlorination, Farm wastes, Water pollution, Biochemical oxygen demand, Lagoons, Sludge, Waste disposal, Laboratory tests, Microorganisms, Salmonella, Effluents, Shellfish, Waste treatment, Oxidation lagoons.
Identifiers: Residual coliform densities, Underwater lagoon, Most probable number.

The presence of year round duck farms in the Moriches Bay area has resulted in pollution which interferes with other legitimate uses of these waters. A study was made and the results are reported in this paper. The conclusion is that the successful disinfection of duck farm lagoon effluents by chlorination would require a number of additions to, and changes in, present treatment practice. These would include (1) a separate basin to provide 15 minute contact time between the chlorine and the settled effluent; (2) facilities for adding the chlorine and thoroughly mixing it with the effluent; (3) some means of dose and/or residual control of the chlorination by the farm operator; (4) some administrative means of ensuring compliance with this required treatment. (Hazen-Iowa State)

0290 - C4

CORYNEFORM BACTERIA IN POULTRY DEEP LITTER,
Edinburgh Univ. Dept. of Bacteriology.
H. E. Schefferle.
Journal of Applied Bacteriology, Vol 29, No 1, 1966. p 147-160, 2 tab, 57 ref.

Descriptors: *Bacteria, *Poultry, Farm wastes, Hydrogen ion concentration, Laboratory procedure, Decomposing organic matter, Biodegradation, Salt tolerance, Organic acids, Ureas, Vitamin B, Ammonia, Genetics, Classification, Pollutant identification, Waste treatment.
Identifiers: *Coryneform bacteria, Litter, Uric acid, Biochemical characteristics, Growth factors, Deep litter, Build up litter.

A detailed discussion of bacteria found in poultry litter is presented. The most frequently occurring bacteria in poultry litter is the coryneform. The paper discusses the characteristics and classification of the coryneform bacteria isolated during the investigation. The procedures for isolating and differentiation of the various strains is discussed. The actual counts of coryneform bacteria in the region 10 to the 9th power - 10 to the 11th power/g of fresh material did not appear to be related to the physical conditions of the litter. Three hundred and eleven strains of coryneform bacterial were examined and compared to those found in poultry litter. (Hazen-Iowa State)

0291 - C4

COMPARISON OF MEDIA FOR ISOLATION OF SALMONELLAE AND SHIGELLAE FROM FECAL SPECIMENS,
Center of Disease Control, Atlanta, Ga. Enteric Bacteriology Unit.
C. Dunn, and W. J. Martin.
Applied Microbiology, Vol 22, No 1, p 17-22, July 1971. 5 tab, 38 ref.

Descriptors: *Salmonellae, *Shigellae, *Pathogenic bacteria, Laboratory, Enteric bacteria, Bacteria, Isolation, Waste treatment.
Identifiers: Transport media, Plating media, Enrichment broth media, Bacteria population, Clinical specimens, Isolation rate, Recovery rate.

Five transport media, eight plating media, and three enrichment broth media for the isolation of salmonellae and shigellae were evaluated. Eight laboratories in widely separated regions of the United States participated in this evaluation by submitting 490 fecal specimens in the transport media provided. The results suggest that the newer transport media may not offer any advantage over the use of buffered glycerol-saline in the isolation of these enteric pathogens. Shigellae were best isolated by direct inoculation, whereas salmonellae were isolated in greater numbers after tetrathionate (without Brilliant Green) enrichment with subsequent culturing on the plating medium. The use of a variety of plating media is recommended for the recovery of a larger number of these enteric pathogens. (Bundy-Iowa State)

0292 - A3, A9

AGRICULTURAL LAND DRAINAGE AND STREAM POLLUTION,
John M. Henderson.
Proceedings of the American Society of Civil Engineers, SA6, Vol 88, November 1962. 4 tab, 1' ref, p 61-75.

Descriptors: *Water pollution sources, *Biochemical oxygen demand, *Drainage effects, Public health, Waste water treatment, Zoonoses, *Farm wastes, Waste identification, Diseases, Runoff, Chemical properties, Physical properties.
Identifiers: *Human disease hazards, Organic pollution, Health hazards, Waste characteristics, Water-borne diseases, Population equivalents.

The inherent characteristics of organic pollution contributed to agricultural land drainage by farm animals are investigated as well as whether this contribution can be a significant problem in stream pollution. The nature of abatement measures is outlined, together with their practicability and effectiveness. Human diseases hazards in water-borne animal wastes are reviewed. (Christenbury-Iowa State)

0293 - F4

SOUTHERN WORKERS REPORT RESEARCH,
W. M. Smith.
Poultry Digest, March 1971, p 136-137.

Descriptors: *Eggs, *Effects, *Poultry, *Farm wastes, DDT, Phosphorus, Proteins, Confinement pens, Oysters, Calcium, Feeds, Amino acids, Wheat, Sodium.
Identifiers: *Egg shells, Egg quality, Egg production, Albumen, Chicken housing, Cow manure.

The text gives summaries of papers presented at a recent meeting of the Association of Southern Agricultural Workers at Jacksonville, Florida. Lighting eggs during incubation may hasten their hatching. Egg production drops after six weeks of feeding DDT at 1200 ppm; shell thickness and shell weight are reduced about 10%. Wire-floor-reared pullets were heavier at 4 and 20 weeks, laid better, and lived better than those raised on litter. Oyster shell strengthens egg shells. Caged hens require more sodium in the ration than do those on litter. (Hazen-Iowa State)

0294 - A8, C4

MANURE MITES IN INTEGRATED FLY CONTROL.
Poultry Digest, February 1971. p 68.

Descriptors: *Poultry, *Biocontrol, Mites, Farm waste, Larvae, Environmental effects, Population, Predation, Air temperature, Pollution abatement, California.
Identifiers: *Fly control, Mesostigmatid, Thinoseis spinosus, Fuscuropoda vegetans.

The manure mite is a biological control method in which a predator population eliminates a fly problem. Several species of mites have been found in California as being associated with the poultry industry. Some of the different mites being associated with flies on poultry ranches include Mesostigmatid mite, Thinoseis spinosus, and the Fuscuropoda vegetans. These mites do not get on people or birds, but they stay in the manure. They are most active in the winter, and can easily be seen on the surface of the manure when it cools off. The manure mite is a major predator on fly eggs. The manure mite in itself will not control flies, but can be used along with pesticides for control. (Bundy-Iowa State)

0295 - B2, D4

OXIDATION DITCH IN CAGE LAYER HOUSE.
Poultry Digest, July 1971. p 337.

Descriptors: *Poultry, *Farm waste, Bacteria, Odor, Foaming, Water circulation, Solids, Waste treatment, Biochemical oxygen demand, *Waste water treatment, *Oxidation lagoons.
Identifiers: *Manure water mixture, Feathers, Mechanical failure, Cage laying house, Oxidation ditch.

An oxidation ditch under a laying flock presented no major problems during a two year study. This was a study made on a 936 bird caged flock in Northern Ireland. The oxidation ditch is 68 feet long with a channel width of 44 inches. The liquid depth is maintained between 3 1/4 to 3 1/2 feet deep for an approximate capacity of 1.8 cubic feet per bird. Waste production of the birds averaged 254 pounds per day with a biological oxygen demand of the fresh droppings of 40,860 parts per million. This was a daily B.O.D. load on the ditch of 10.3 pounds. It was necessary to empty the ditch completely when the solids content of the liquid rose above the 30,000 ppm level - about twice a year. Bacterial activity in the ditch during the first cycle of storage was responsible for loss of 43% of the total solids, 60% of the chemical and biological oxygen demand, and 66% of the nitrogen. The manure water mixture in the ditch was odorless. (Bundy-Iowa State)

0296 - B1, F5

A NEW APPROACH TO CAGE WASTE DISPOSAL IN A CANINE LABORATORY,
Veterans Administraton Hospital, West Roxbury, Mass. General Medical Research Dept.
P. Godin, and J. Belko.

Laboratory Animal Care, Vol 18, No 3, June 1968. p 401-404, 2 fig, 2 ref.

Descriptors: *Waste disposal, *Animal parasite, Laboratory, Labor, Moisture content, Water pollution control, Equipment, *Pollution abatement.
Identifiers: *Automatic flush waste system, Dog cage wastes, Compactness, Flushing.

The need for the improvement of animal housing to meet future standards prompted the design of a new type of animal cage at the Veterans Administration Hospital. This particular dog cage system has been in use for 3 years, housing 25 animals in a small area, yet meeting all the requirements for good animal care. The cages are custom-installed prefabricated fiberglass, featuring a central drain that ties into existing public sewer lines. An automatic flush system connected to the drain lines reduces both odors and labor. The general condition of the dogs have improved, and the number of parasites diminished with the way of cleaning. The relative humidity rises to 57% in the first hour after cleaning, then maintains a level of 47-50% throughout the day. This system may readily be adopted to existing or new animal facilities. (Bundy-Iowa State)

0297 - B3

BROODER-GROW CAGES OVER DEEP PIT,
Roland C. Hartman.
Poultry Digest, April 1971, p. 165-168.

Descriptors: *Poultry, *Farm wastes, Structural design, Ventilation, Waste storage.
Identifiers: Pit storage, Cages.

This article describes a brooder-growing house for pullets. The building measures 36' X 390' and has four 370' rows of double-decked cages on A-frames designed for starting 38,000 pullet chicks and rearing them until 20 to 22 weeks of age. The cages are set up over a deep pit. Air is exhausted from beneath the floor and brought in under the eaves. Heat is supplied by a hot water pipe running down the center of each row of cages. (Parker-ISU)

0298 - A2, B1

MANAGING SWINE WASTES TO PREVENT POLLUTION,
Nebraska Univ., Lincoln. Agricultural Engineering Extension.
E. A. Olson.
Nebraska Farmer, April 1971, p. 18, 20, 22, 2 fig.

Descriptors: *Farm wastes, *Wastewater disposal, Lagoons, Waste storage, Settling basins, Hogs.
Identifiers: *Waste management, Nebraska Water Pollution Control Council.

The management of swine wastes to keep them from polluting our streams is one of the new production problems facing the swine producer. Site selection is especially important as related to odor problems and sufficient space for waste handling facilities. Runoff from swine lots must not reach streams. Therefore facilities must be built to store and dispose of wastes. This article discusses some systems and problems associated with swine waste disposal. (Parker-ISU)

0299 — E1, F5

HYDROLOGY OF SPRAY - RUNOFF WASTEWATER TREATMENT,
Robert S. Kerr, Water Research Center, South Central Region, Federal Water Pollution Control Administration U.S. Dept. of the Interior. Ada, Oklahoma.
Richard E. Thomas, James P. Law, Jr., Curtis C. Harlin, Jr.
Journal of the Irrigation and Drainage Division Proceedings of the American Society of Civil Engineers, Vol. 96, No. 3, 1970, P. 289-298. 4 tab, 4 fig. 15 ref.

Descriptors: *Hydrology, *wastewater treatment, *soil disposal fields, runff, systems analysis, water balance, water measurement, sprinkler irrigation.
*Identifiers: *Spray runoff, sprinkler application.

A 400-acre soil treatment system designed to treat 3.8 mgd of wastewater from a cannery was selected for a research study. Four watersheds with a total area of 11.4 acres were instrumented to evaluate the hydrology of the treatment system. The liquid measuring procedures used in the 12-month study accountd for 93% of the total liquid applies. On a monthly basis evaporative losses ranged from 9% to 35% of the liquid accounted for; and deep soil percolation ranged from 10% to 28% of the liquid accounted for. A change in the spray schedule from 6 hr per day to 8 hr per day and a reduction in the treatment area used from June through September suppressed but did not eliminate the effect of summer weather on the ratio of evaporative losses to runoff. During the 12-month study, evaporative processes accounted for 18% of the liquid; 61% returned to the surface stream as runoff; and 21% percolated through the soil. These values were obtained during a relatively wet year; therefore, evaporative losses could be expected to be relatively greater in normal and dry years. (Parker - ISL)

0300 — A1, B1, F4

WASTE MANAGEMENT OF LIVESTOCK OF THE PLAINS STATES WITH EMPHASIS ON BEEF CATTLE,
The Ad Hoc Interdisciplinary Committee on Feedlot Pollution of the Research Committee, Great Plains Agricultural Council.
The Research Committee by the Ad Hoc Interdisciplinary Committee on Feedlot Pollution of the Research Committee. Great Plains Agricultural Council. July 1969. pp. 1-11.

Descriptors: *Farm wastes, *livestock, odor, feedlots, air pollution, ammonia, sprinkler irrigation, lagoon, microbial, bacteria, runoff.
Identifiers: *Great Plains, Composting.

Representatives of the ad hoc committee met in Lincoln, Nebraska on February 10 to consider the charge outlined by the Research Committee of the Great Plains Agricultural Council: 'to study the scope and nature of current research on problems of feedlot pollution and to develop recommendations for consideration by the research committee at their next meeting." The ad hoc committee set up its organization at this meeting, outlined its procedure, identified sources of its information, and adopted the following resolution: "This Committee will be concerned with waste management of livestock of the Plains States with emphasis on beef cattle." At its second meeting on May 13 and 14, the ad hoc committee reviewed past and current research in the United States. It inventoried and discussed in detail the relevant research activity in th Great Plains. Problem areas were identified which, in the Committee's opinion, have special significance for the Great Plains and which appear to require additional research emphasis. This report summarizes the review of the national research effort and comments on its significance to research planners in the Great Plains. Current research in the Great Plains is outlined. Finally, this report states the Committee's recommendations for research emphasis in the Great Plains and for the establishment of a standing committeee to implement interstate coordination of research in waste management. (Bundy - ISU)

0301 - B1, F2

STATE AGENCIES REGULATING CONFINED ANIMAL FEEDING OPERATIONS,
Environmental Protection Agency, Washington, D.C.
J. M. Sweeten.
Environmental Protection Agency Division of Technical Operations Open-File Report (TO 01.0 .543/1) 1971. 37 p.

Descriptors: *Farm wastes, Federal Government, *State Governments, Regulation, Control, Feed lots, Standards, *Administrative agencies.
Identifiers: *Regulatory control.

State Agencies that regulate livestock feeding operations and their responsibility with respect to environmental problems are identified. The reader will thus know which agencies should be contacted about establishing a confined feeding operation, improving or expanding existing feeding facilities, and reporting nuisances arising from feedlots. The information was collected by sending a letter to each State solid waste planning agency requesting: (1) the name and address of all State agencies that should be contacted prior to establishing a confined feeding operation; (2) the types and limits of control exercised by these agencies. The types of agencies exerting regulatory control over animal feeding operations in each State are summarized in a table. The availability of technical assistance in designing feedlot and waste treatment systems is included when specifically mentioned by the respondent agencies. General observations regarding nationwide control over animal feeding operations are made. (Bundy-Iowa State)

0302 - A2, A9, C4

SALMONELLA INFANTIS IN CATTLE FEEDLOT RUNOFF,
Kansas State Univ., Manhattan. Dept. of Bacteriology.
J. R. Miner, L. R. Fina, and Cheryl Platt.
Applied Microbiology, Vol. 15, No. 3, May 1967, p 627-628, 1 tab, 10 ref.

Descriptors: *Farm wastes, *Runoff, *Pathogenic bacteria, Microorganisms, Cattle, Salmonella, Pollutant identification.
Identifiers: *Feedlot runoff, *Salmonella infantis, Litter.

Ten isolates of Salmonella infantis (serologically typed) were found in litter and runoff collected from two experimental feedlots near the Kansas State University campus. Pathogenic implications are discussed relative to recreation water sites. Agricultural runoff maybe a source of viable salmonellae. (Christenbury-ISU)

0303 - C4

METABOLIC FATE OF UBIQUINONE-7 Isolation and Identification of Metabolites in the Urine, Liver, Bile and Feces,
Takeda Chemical Industries Ltd., Osaka (Japan). Biological Research Labs.
Takeshi Fujita, Shigeharu Tanayama, and Ziro Suzuoki.
Journal of Biochemistry, Vol. 69, No. 1, 1971, p 63-71, 9 fig., 2 tab., 17 ref.

Descriptors: Radioactivity, Urine, Laboratory tests, Chromatography, Chemical analysis, Chemical properties.
Identifiers: *Ubiquinone-7, Urinary metabolites, Acid chromatography.

The metabolic conversion of methoxy-14C-labeled ubiquinone-7 was investigated in the rat following intravenous injection. From urine two radioactive metabolites were isolated and identified. The major metabolite is a new compound whose structure is 2,3-dimethoxy-5-methyl-6 (3'-methyl)-1, 4-benzoquinone (compound B) whereas the other one is gamma-lactone of 2,3-dimethoxy-5-methyl-6- (5'-carboxypentyl-3'-hydroxy-3'-methyl)-1, 4-benzo-quinone (compound A). Compound B accounted for about half of the urinary metabolites and compound A a quarter. Both metabolites were excreted as conjugates into urine. About 90% of the hepatic radioactivity was identified as unchanged ubiquinone-7. Chromatographic examinations indicated the occurrence of compounds A and B in bile and feces, presumably as conjugates. The main biotransformation of ubiquinone-7 was thus proved to be oxidative shortening of the side chain. The chain with 7 isoprenoid units was eventually degraded to 3-carboxy-3-methylpropyl group in compound B via 5-carboxypentyl-3-hydroxy-3-methyl group in compound A, possibly due to Beta-oxidation of the latter. Metabolic conversion of ubiquinone-7 to ubiquinone-9 or ubiquinone-10 was not recognized in the present studies. (Hazen-ISU)

0304 - A5, D1, E1

STATE OF THE ART REVIEW: TREATMENT AND DISPOSAL OF SWINE WASTES,
Mississippi State Univ., State College, and Soil Conservation Service, New Albany, Miss.
Adnan Shindala, and James H. Scarbrough.
Water and Sewage Works, Vol. 118, No. 2, p 50-57, February 1971. 2 fig, 4 tab, 44 ref.

Descriptors: *Odor, *Waste treatment, *Waste disposal, Chemical oxygen demand, Water pollution, Air pollution, Lagoons, Anaerobic digestion, Disposal, Farm wastes, Cattle, Confinement pens, Hogs, Biochemical oxygen demand, Alkalinity, Design criteria.
Identifiers: Odor production, Odor control, Environmental control, Swine, Characteristics, Loading rates.

Confinement production of animals yields large volumes of animal wastes which constitutes a tremendous oxygen demand on natural streams if not disposed of properly. Animal wastes disposal has become one of the major problems facing the livestock industry today. Among the many combinations of processes suggested for the treatment of animal wastes, lagooning has received the widest acceptance. The low cost of construction and operation of lagoons has resulted in their wide adoption for the treatment of all types of animal wastes. If properly located, designed, constructed, and maintained, anaerobic lagoons provide the most economical means of treating and disposal of swine wastes. Effluents from anaerobic lagoons are offensive and must receive further treatment. Anaerobic lagoons must only be used as an initial step rather than a complete facility and must be followed by other means of treatment prior to adequate and safe disposal of the effluents. (Hazen-ISU)

0305 - C3

RETARDING EFFECT OF DESSICATION ON NITROGEN MINERALIZATION IN ORGANIC MANURES,
Indian Agricultural Research Inst., New Delhi. Div. of Soil Science and Agricultural Chemistry.
R. D. Laura, and M. A. Idnani.
Current Science, Vol. 40, No. 7, 1971, p 158. 1 tab, 3 ref.

Descriptors. *Drying, Nitrification, Nitrogen compounds, Nitrogen, Farm wastes.
Identifiers: Anaerobic fermentation, Microbial decomposition, Nitrogen mineralization.

Nitrogen in organic manures of animal or vegetable origin is complex in chemical nature due to its presence in the form of proteinaceous compounds which are largely insoluble in water. If such nitrogen is to be transformed to mineral forms which are easily available to plants, the parent materials must be subjected to the agencies of decomposition in the soil. The effect of drying on the quantity of nitrogen mineralized in an animal manure, viz., dung spent-slurry is the object of an investigation. Sun-drying of spent-slurry has drastically reduced the rate of nitrogen mineralization. The reason may be irreversible desiccation of organic colloids of the manure on sun-drying and thus their increased resistance to subsequent microbial decomposition in soil. The conclusion is that apart from the chemical composition of an organic manure, the treatment given to it before applying to soil should also be taken into consideration while evaluating its nitrogen supplying power to growing plants. The practical implication is that to explore full potential of the benefits that can be obtained from organic manures, they should never be subjected to drying before applying. (Hazen-ISU)

0306 - D4, F5

ANAEROBIC DIGESTION FAILURES,
Bergen County Sewer Authority, Little Ferry, N.J.
Stanley A. Peterson, and Herman R. Zablatzky.
Journal Water Pollution Control Federation, Vol 40, No 4, p 581-585, April 1968. 2 fig, 5 tab, 3 ref.
Descriptors: *Anaerobic digestion, *Alkalinity, Lagoons, Hydrogen ion concentration, Waste water treatment, Sludge, *Sludge digestion, Digestion (Decomposition).
Identifiers: Isolation, *Ammonium alkalinity, Thickeners, Volatile acids, Gas production, Sodium hydroxide, Potassium hydroxide, Calcium oxide, Gas agitation.

Two separate incidents of digester failure are discussed, along with the materials and methods used to help them recover. Parameters of pH, alkalinity, CO2 content, volatile acids content, and gas production were continuously monitored and that data is presented in graphical form. Under-concentration of feed sludge may lead to failure by the depletion of alkaline buffering materials. Over concentration of feed sludge allows buildup of ammonium alkalinity to toxic levels. One of the essentials of good digester maintenance is early diagnosis of problems through close observance of the major parameters. Ideal sludge concentration varies from plant to plant and must be determined by the individual operator. (Lowry-Texas)

0307 - C4

ISOLATION OF GRANULOSIS VIRUS FROM HELIOTHIS ARMIGERA AND ITS PERISTENCE IN ABIAN FECES,
Cape Town Univ., (South Africa). M. R. C. Virus Research Unit.
Hela Gitay, and A. Polson.
Journal of Invertebrate Pathology, Vol. 17, No. 2, p 288-290, 1971. 4 fig.

Descriptors: *Viruses, *Isolation, Farm wastes, Birds, Laboratory tests.
Identifiers: *Cattle egret, Procedure, Feeding habits.

This paper describes the procedures by which a granulosis virus was isolated. Feces of the Cattle egret, Arboela ibis, that feed on the caterpillars of the bollworm and the lucerne caterpillar were collected and found to contain intact inclusion bodies of granulosis virus but no polyhedra. The granulosis virus was isolated from the bollworm caterpillars, Heliothis armigera. (Christenbury-ISU)

0308 - B1

DEEP PIT SLAT-FLOOR BREEDING HOUSE,
Roland C. Hartman.
Poultry Digest, December 1970, p. 580-583. Fig. 7.

Descriptors: *Poultry, *Farmwastes, Ventilation, Design data.
Identifiers: *Slatted floor, Evaporative cooling.

This is a description of a slatted floor confinement house for poultry breeding flocks. The building has a 6 feet-5 inches ceiling height room above a 6 feet-0 inch pit, all above ground level. Slats are made of 2 X 4's split to 1 7/8 inches X 1 7/8 inches. Fans draw air from the pit area. The air enters through continuous vents near the ceiling passing first through an evaporative cooler made of a fogger and cooling pad. INCHEShese units were built by Pace/Setter Inc. on the high desert near Hesperia, California. (Parker-ISU)

0309 — A5, B1,D2

CONTROL OF POULTRY HOUSE EXHAUST ODORS,
USDA Agricultural Research Service.
George B. Willson.
Poultry Digest, p. 332-334, July 1971. 2 fig., 1 tab., 4 ref.

Descriptors: *Poultry, *odors, *particle size, air circulation, waste treatment, drying, wetting, air pollution effects, waste.
Identifiers: *Air filter system, water scrubbing, masking agents, ammonia-like odor, respirator.

Filtering exhaust air from poultry houses will reduce the odor. Pad-type filters were effective in removing the dust and reducing the odor, but clogged too quickly to be practical. Baffle impingement filters were evaluated for dust and odor control. The effectiveness of removing the dust and odor was improved when the vanes were washed clean. The study was conducted at Uniontown, Maryland in three 12,000 bird windowless caged laying houses. The spray of .8 gallons per minute per hen was required for the best results. The water was recycled through a storage tank to reduce the amount of water required to operate the system. It was concluded that water spray chambers can reduce substantially the odor exhaust from the building. Studies also showed there is not a direct relationship between dust and odor. (Bundy-Iowa State).

0310 - A6, D3

IMPROVEMENTS IN THE COLLECTION OF HYDROGEN SULFIDE IN CADMIUM HYDROXIDE SUSPENSION,
Washington State Univ., Pullman. Coll. of Engineering.
W. L. Bamesberger, and D. F. Adams.
Environmental Science and Technology, Vol 3, p 258-261. 1969. 2 fig, 3 tab, 11 ref. Grant No. AP-00215 Division of Air Pollution, U.S. Public Health Service.

Descriptors: *Hydrogen sulfide, *Oxidation, Chemical reactions, Analytical techniques, Ions, Laboratory tests, Efficiency performance, Colloid suspension, Hydrogen ion concentration.
Identifiers: *Cadmium hydroxide, Absorption solution, Aspirator, Alkaline solutions, Jacobs method.

The technique of collecting hydrogen sulfide at ambient air concentrations in cadmium hydroxide suspension, in use for more than 10 years, is reported to prevent loss from sulfide oxidation. A comparison of this procedure with bromine microcoulometric titration and with calculations of the anticipated hydrogen sulfide concentrations produced in a laboratory gas dilution system revealed an unpredictable and nonreproducible loss of hydrogen sulfide as high as 80% during collection of a 2-hour impinger sample containing cadmium hydroxide suspension. Evidence is given of the photodecomposition of cadmium sulfide in the impinger and techniques are described to reduce loss of sulfide during sampling and storage. The suggested modification provides reproducible hydrogen sulfide recoveries. Reliable quantitative results were obtained. (Bundy-Iowa State)

0311 - A5, D4

WHY STIRRING MANURE REDUCES ODORS,
Pennsylvania State Univ., State College. International Poultry Industries Exposition.
Glenn O. Bressler.
Poultry Digest, p 60, February 1971.

Descriptors: *Anaerobic condition, *Air circulation, *Aeration, Anaerobic condition, Odors, Bacterial, Drying, Gases, Velocity, Movement, Air pollution, *Farm wastes, *Waste treatment.
Identifiers: Sewerage gas, Anaerobic bacteria.

Anaerobic bacterial action is the primary cause of the offensive odors in manure. High velocity air circulating over the droppings hinders the bacterial action and reduces the odor. However, the high velocity air movement over the manure does not stop the bacterial action underneath the surface. To rid the odor producing gases from forming, the anaerobic bacteria must be destroyed. By aerating with fans and stirring several times daily, most of the anaerobic bacteria are destroyed. This combined operation destroys the odor as well as increases the speed of drying the droplets. (Bundy-Iowa State)

0312 - C4
REDUCTION AND ESTERIFICATION OF CHOLESTEROL AND SITOSTEROL BY HOMOGENATES OF FECES,
Montefiore Hospital, Bronx, N.Y.
R. S. Rosenfeld, and L. Hellman.
Journal of Lipid Research, Vol 12, No 2, 1971, p 192-197. 4 tab, 23 ref.

Descriptors: *Lipid, Microorganisms, *Waste treatment, Incubation, Aluminum compound, Waste water treatment, Acids.
Identifiers: *Cholesterol, *Sitosterol, *Feces, Free sterols, Bile acid, Estification.

Mixtures of cholesterol-1,2-3H and sitosterol 4-14C have been incubated with suspensions of feces in order to compare the behavior of the phytosterol with transformations known to take place with cholesterol under these conditions. Within the limitations of the study both labeled sterols were esterified to the same extent, and reduction of the delta 5 double bond to the saturated analogue proceeded equally in both substances. After correcting for procedural losses, the recoveries of 3H and 14C from the incubations were always less than the controls; this strongly indicates destruction of sterol by feces microorganisms. (Bundy-Iowa State)

0313 - B3, D2
TYPES OF MANURE DRYERS.
Poultry Digest, p 338-340, July 1971.

Descriptors: *Poultry, *Farm wastes, *Drying, Capital investment, Moisture content, Dehydration, *Waste treatment.
Identifiers: Rotary dryers, Conveyor dryers, Vibrating conveyor dryers, Vibrating type conveyor, Three pass drum, 2 stage drying.

With the increase in demand for poultry manure drying, several dryers operating on different principles have been put on the market. One type of dryer subjects manure to 1400 degrees of temperature in a rotating drum. Another type dryer uses the conveyor principle. The conveyor-type unit pulls the manure back and forth through a unit with air temperatures of 400 to 600 degrees. A modified version of the conveyor type vibrates. This is a new type expected to be on the market during the summer of 1971. The temperature ranges from 1000 degrees at the start and drops to 400 degrees. A three-pass drum method of drying utilizes hot gas temperatures up to 1800 degrees, and allows 75 feet of horizontal travel in a 25 foot drum. A two stage drying method is being promoted which will reduce the drying cost. The first stage uses mechanical stirrers on the manure aided by a high velocity air current. This first stage reduces the moisture without applying heat to the manure. While the second stage process drys the manure down to the desired moisture content. The two stage process allows more manure to be dryed or allows for a smaller dryer. (Bundy-Iowa State)

0314 - A5, A6, C3, C4, D1
GASES AND ODORS FROM POULTRY MANURE: A SELECTED BIBLIOGRAPHY,
Merck and Co., Rahway, N.J. Quinton Research Labs.
W. E. Burnett.
Poultry Science, Vol 50, No 1, p 61-63, January 1971. 35 ref.

Descriptors: *Poultry, *Odor, *Gases, *Farm wastes, *Bibliographies, Research and development, Management.

This is a bibliography of 35 articles pertaining to gases and odors from poultry wastes. The articles are grouped into three divisions: (1) The microbiology and chemistry of gas and odor production; (2) Identification and determination of gases and odors; (3) Odor control methods. (Hazen-Iowa State)

0315 — A7
IF COW MANURE BREAKS DOWN DDT. . . ,
R. C. Hartman.
Poultry Digest, March 1971. pp. 109.

Descriptors: *DDT, Farm wastes, Poultry, Insecticides.
Identifiers:* Decomposition, DDT, build-up.

Cow manure reportedly breaks down DDT in the soil in a few weeks. The question is raised as to whether poultry manure will work as well. Studies need to be made to determine whether it is necessary to use fresh poultry manure to degrade DDT, or whether processed manure can do the same job. (Hazen—Iowa State)

0316 - A5, A6, A9, C5
EFFECTS OF ATMOSPHERIC AMMONIA ON THE PIG,
Ohio Agriculture Research and Development Center, Wooster. Dept. of Agricultural Engineering; and Ohio Agriculture Research and Development Center, Wooster. Dept. of Animal Science.
D. P. Stombaugh, H. S. Teague, and W. L. Roller.
Journal of Animal Science, Vol 28, 1969, p 844-847. 2 fig, 2 tab, 7 ref.

Descriptors: *Hogs, *Ammonia, Air pollution, *Air pollution effects, Toxicity, Ventilation, Farm wastes, Confinement pens, Odor, Gases, Growth rates, Laboratory tests.
Identifiers: *Response, Anhydrous ammonia, Feed consumption, Feed efficiency, Concentration, Exposure time.

Duroc pigs were subjected to four levels of ammonia air contamination. Ammonia concentration had a highly significant adverse effect upon feed consumption and average daily gain. There was no significant effect upon efficiency of feed conversion. Corynebacterium and Pasteurella were isolated from the ethmoid turbinates of two animals, otherwise all gross, microscopic and bacteriological observations were unaffected by ammonia concentrations. Frequency of coughing was increased in animals exposed to the higher ammonia levels. (Hazen-Iowa State)

0317 - A5, A6, A9, D1
AIR POLLUTION ASPECTS OF ODOROUS COMPOUNDS,
Litton Systems, Inc., Bethesda, Md. Environmental Systems Div.
Ralph J. Sullivan.
Available from the National Technical Information Service as PB-188089, $3.00 in paper copy, $0.95 in microfiche. September 1969. 245 p, 3 fig, 444 ref. Contract No PH-22-68-25.

Descriptors: *Odor, *Air pollution effects, *Classification, Air pollution, Air environment, Pollution abatement, Costs, Property values, Farm wastes, Effects, Public rights, Theoretical analysis, Economics.
Identifiers: *Odor perception, *Sources, Detector, Nose, Description, Characteristics, Intensity, Acceptability, Public opinion, Allergies.

Offensive odors provoke people into complaining about air pollution. They may cause both mental and physiological effects such as nausea, headache, loss of sleep, loss of appetite, impaired breathing, and in some cases, allergic reactions. The most offensive odors come from Kraft paper mills, animal rendering plants, chemical plants, petroleum refineries, diesel engines, sewers and sewage treatment plants, and metallurgical plants. The most generally accepted method for abating most odor pollution problems is incineration. Other methods of control include: adsorption, chemical scrubbing, containment, process changes, and masking or counteracting the odors. The cost of abatement depends on the odor pollution problem and the source. The human nose is the only reliable odor detector. (Christenbury-Iowa State)

0318 - A2, A4, C3
RUNOFF, SOLID WASTES, AND NITRATE MOVEMENT ON BEEF FEEDLOTS,
Agricultural Research Service, Lincoln, Nebr.; and Nebraska Univ., Lincoln. Dept. of Agricultural Engineering.
C. B. Gilbertson, T. M. McCalla, J. R. Ellis, O. E. Cross, and W. R. Woods.
Journal Water Pollution Control Federation, Vol 43, No 3, Part 1, p 483-493, Mar 1971. 11 p, 2 fig, 6 tab, 18 ref.

Descriptors: *Farm wastes, *Water pollution sources, *Path of pollutants, *Confinement pens, Runoff, Water quality, Nitrates, Groundwater, Surface waters, Water pollution, Industrial wastes.
Identifiers: *Feedlot wastes.

A study of the effect of feedlot slope and cattle densities on the quantity and quality of runoff resulting from rainstorms and snowmelt, the downward movement of pollutants into the soil profile on unpaved feedlots, and the amount of solids accumulation on the feedlot surface revealed that feedlots with 18.58 sq m/head yielded 5.6 metric tons dry matter/day/ha, whereas those with 9.29 sq m/head yielded 7.6 metric tons/day/ha. Feedlot slope had little effect. About 30 percent of the solids were volatile. Runoff quantity and quality depended more on rainfall than slope or cattle density, but high-density lots yielded 130 to 170 percent more winter runoff than low-density lots. Winter runoff averaged 6.2 to 17.6 metric tons/ha-cm, with about 50 percent volatile. Nitrate movement in soil after 1 yr was minimal. (Knapp-USGS)

0319 - D4, E1
FARM WASTE DISPOSAL SYSTEMS,
Purdue Univ., Lafayette, Ind. Dept. of Agricultural Engineering.
A. C. Dale.
Cooperative Extension Service, Purdue University, AE-80, Feb 1971. 10 p, 1 tab, 5 fig, 34 ref.

Descriptors: *Farm wastes, *Waste disposal, *Lagoons, *Oxidation lagoons, Aerobic conditions, Anaerobic conditions, Algae, Organic matter, Volume, Drying, Odor, Nitrogen, Aeration, Hogs, Cattle, Poultry, Research and development, Soil, Soil contamination.
Identifiers: *Disposal systems, *Land disposal, Oxidation ditches, Aerated lagoons, Composting, Refeeding, Anhydrous ammonia, Waste characterization.

In this publication the present available alternatives for animal waste disposal and criteria for selection of these methods are presented. A brief literature review tells of research being done in all areas and aspects of animal waste disposal. Land disposal still remains the most suitable and most widely used disposal method. Research indicates that approximately 250 pounds of nitrogen can be added to each acre of soil without unduly polluting it. Other methods of disposal discussed are aerobic, anaerobic, and mechanically aerated lagoons, as well as oxidation ditches, composting, and drying. Recommendations are made for the chemical treatment of animal wastes to reduce odors while spreading. (White-Iowa State)

0320 - F3

AGRICULTURAL WASTE IN AN URBAN ENVIRONMENT.

New Jersey Animal Waste Disposal Task Force.

Proceedings of the Conference, 'Agricultural Waste in an Urban Environment,' Atlantic City, New Jersey, Sept 14-17, 1970. New Jersey Animal Waste Disposal Task Force. 256 p.

Descriptors: *Farm wastes, *Water pollution control, *Environment, Waste disposal, Cities, Grants, Research and development, Legislation, Communication, Poultry, Cattle, Odor, Lagoons, Aeration, Nitrogen, Moisture content, Aeration, Costs, Sewage, Agriculture, *Waste water treatment, Waste treatment.
Identifiers: *Urban environment, Land-Grant Colleges, Funding, Public relations, Refeeding, Land disposal, Research needs, Biological systems, Waste handling, Research funds, Recycling.

The groundwork for the conference 'Agricultural Waste in an Urban Environment,' was laid several years ago when the New Jersey Animal Waste Disposal Task Force was formed. Since its formation the Task Force has moved in four directions in an effort to find a solution to the agricultural waste problem. These have consisted of studying current laws, making maximum use of available methods of disposal, utilization and odor control, encouraging research, and informing the public of the issues. The conference was based on these four approaches. Various resources available to deal with the problem were brought together and, consequently the attitude of people of all levels of the economy, both rural and urban, was determined; additional resources were discovered; new interests were created; better communications were established; the latest technology was reviewed; and a plan of action was developed. A resolution passed by the delegates calls for a national conference on this matter by appropriate Federal officials. The main purpose of the conference was to find a way for rural and urban communities to develop their economies and reach their full potentials without becoming a nuisance to each other. (White- Iowa State)

0321 - A5, D4, F5

WASTE DISPOSAL AND POLLUTION, POULTRY PROCESSING,

Ralston Purina Co., St. Louis, Mo. Engineering Waste Disposal Plant.
Rowland Retrum.
Proceedings of the Conference, 'Agricultural Waste in an Urban Environment,' New Jersey Animal Waste Disposal Task Force, p 64-75, Sept 14-17, 1970. 13 tab, 5 fig.

Descriptors: *Farm waste, *Poultry, Water pollution, *Waste water disposal, Sewage, Odor, Biochemical oxygen demand, Organic matter, Annual costs, Aeration, Aerobic treatment, Anaerobic digestion, Lagoons, Dissolved oxygen, Condensers, Incineration, Drying.
Identifiers: *Poultry processing, Solids, Rendering plants, Odor control, Chemical scrubbing, Byproducts.

It is the author's intention to attempt to define the problem of waste disposal and pollution with respect to poultry processing, to describe efforts now being made toward solution, to review cost effects, and to indicate promixing directions for accelerated investigation. The problems considered as the major pollution problems are feather litter, water pollution, sewage treatment odors, and rendering odors. Costs and other data are computed for an 80,000 bird per day broiler processing plant with a small associated rendering plant. Suggestions are made for decreasing the total waste load while increasing income. Systems for reducing the odor from both sewage treatment and rendering plants are explained. The odor problem is complex and there are no pat solutions. Any solution will be expensive. (White- Iowa State)

0322 - F1, F3

FUNDING FOR AGRICULTURAL WASTE RESEARCH,

Cornell Univ., Ithaca, N.Y.
N. C. Brady.
Proceedings of the Conference, 'Agricultural Waste in an Urban Environment,' New Jersey Animal Waste Disposal Task Force, p 89-98, Sept 14-17, 1970.

Descriptors: *Farm wastes, Research and development, Environment, Agriculture, Water pollution, Foods, Domestic wastes, Industrial wastes, Properties, Waste disposal, Grants, Population, Legislation, Education, *Costs.
Identifiers: *Research funds, Agricultural waste problem, Environmental quality, Intensive animal agriculture.

Three basic assumptions are made on which to establish a common ground. First the agricultural waste problem is serious. Secondly, agricultural waste problems are not extensions of those waste problems facing municipalities and industry. Thirdly, the solutions to the agricultural waste problem require knowledge that we do not now have. These assumptions lead to the fact that research and adequate funding are badly needed. The following are avenues that could be developed for solving agricultural waste problems in an urban environment: (1) Agriculture and its related industries must see environmental pollution as a major threat to themselves; (2) Agriculture should work closely with state and Federal legislators to obtain funding for direct application to State Experiment Stations and USDA research agencies; (3) Greater coordination between agencies is needed so that a larger proportion of the Federal Water Quality Administration's research funds can be used for animal waste studies; (4) We must not ignore the possibilities of reorienting research funds already available, and; (5) The training and education of professionals in agricultural waste management is needed. (White-Iowa State)

0323 — BI, CI, D2, E1

AGRICULTURAL WASTE RESEARCH NEEDS,

Cloisterdale Farms, Inc., Ephrata, Pennsylvania.
Glenn H. Herr.
Proceedings of the Conference, "Agricultural Waste in an Urban Environment," New Jersey Animal Waste Disposal Task Force, September 14-17, 1970, p. 109-117.

Descriptors: *Farm wastes, *poultry, *liquid wastes, *moisture content, volume, odor, ultimate disposal, toxicity, lagoons, sprinkler irrigation, pumping, annual costs, research and development,
Identifiers: *"Shud," community relations, liquid handling, hauling.

A poultry manure disposal method is explained which Cloisterdale Farms in Pennsylvania is presently converting to. With 360,000 hens and 35-40 tons of manure to dispose of daily, a liquid system consisting of lagoon, irrigation and hauling was soon found inadequate. One house was then converted to a semi-dry system in which "rakes" and airflow convert the 70-75% moisture raw waste into a 28-35% moisture product. Its advantages include easier handling, little or no odor, no restrictions on seasonal disposal, no great labor problem, and some as yet un-established value. Remodeling and operational costs are given. It is felt that a sizeable volume of funds is needed to support practical research in the waste disposal area. (White-Iowa State).

0324 - E1

DISPOSAL OF SOLID AGRICULTURAL WASTES - CONCEPTS AND PRINCIPLES,

Cornell Univ., Ithaca, N.Y. Dept. of Civil and Agricultural Engineering.
Raymond C. Loehr.
Proceedings of the Conference, 'Agricultural Waste in an Urban Environment,' New Jersey Animal Waste Disposal Task Force, p 126-134, Sept 14-17, 1970. 12 ref.

Descriptors: *Farm wastes, *Research and development, Waste disposal, Drying, Dehydration, Incineration, Beneficial use, Environment, Water pollution, Temperature, Moisture content, Odor, Feeds.
Identifiers: *Research needs, *Land disposal, Composting, Refeeding, Pyrolysis, Utilization, Waste management.

The state of development regarding suitable disposal methods for agricultural solid wastes is in an embryonic stage. A variety of techniques are possible but little information exists on the broad applicability of the techniques or on the detailed design and use parameter for the techniques with these wastes. Because of technical or economic difficulties, composting, drying and dehydration, incineration, and pyrolysis have not found wide application for animal solid wastes. Refeeding and land disposal offer the greatest opportunities for satisfactory disposal of animal wastes in the near future. The important research needs in the area of animal waste disposal include: (1) more thorough investigation of promising techniques, (2) utilization of non-traditional concepts, (3) evaluation of feasible disposal methods as part of animal production operations, (4) more and detailed cost information, and (5) broad interdisciplinary approaches and studies. (White-Iowa State)

0325 - E3

RECYCLING AND UTILIZATION OF BIODEGRADABLE WASTES IN THE SOIL,

Rutgers-The State Univ., New Brunswick, N.J. Dept. of Agricultural Engineering.
Charles H. Reed.
Proceedings of the Conference, 'Agricultural Waste in an Urban Environment,' New Jersey Animal Waste Disposal Task Force, p 135-139, Sept 14-17, 1970. 2 fig.

Descriptors: *Farm wastes, *Biodegradation, Waste disposal, Water pollution, Nitrogen, Nitrogen compounds, Nitrogen cycle, Research and development, Conservation, Soil, Environment, Agriculture.
Identifiers: *Recycling, Utilization, Biological systems, Materials balance.

The survival of man depends upon the intelligent use of agriculture with its inumerable physical chemical and biological systems and cycles. The author emphasizes that all biodegradable organic wastes could and should be recycled and utilized by natural biological systems on specialized sites or farms. The ability of soils to filter and degrade organic wastes and immobilize potential pollutants is widely recognized. Plants are among the best known converters of nitrogenous compounds to non-pollutional materials. A figure depicts the nitrogen cycle and how organic wastes are recycled by the soil. A chart is presented showing a program for recycling biodegradable wastes. To achieve this objective an interdisciplinary approach must be taken, which will necessitate much research requiring many tax dollars. (White-Iowa State)

0326 - F4

AGRICULTURAL WASTE RESEARCH NEEDS,

Rutgers-The State Univ., New Brunswick, N.J.
Dept. of Agricultural Economics.
George W. Luke.

Proceedings of the Conference, 'Agricultural Waste in an Urban Environment,' New Jersey Animal Waste Disposal Task Force, p 140-141, Sept 14-17, 1970.

Descriptors: *Farm wastes, *Environment, Water pollution, Grants, Population, Surveys, Waste disposal, Volume, Odor, Livestock, New Jersey.
Identifiers: *Waste handling, Masking agents, Environmental quality, Residential areas.

Aided by a grant from the State Department of Health, the Department of Agricultural Economics conducted a survey of livestock enterprises in four agricultural counties in New Jersey to determine the volume of waste, the methods of handling waste, the cost of waste disposal, the attitude of farmers toward the problem of animal waste, and the location of farms relative to residential areas. The results of this survey are given and evaluated. Between 600,000 and 1 million tons of waste are produced and disposed of in the four counties annually. The typical method of disposal is on the land. Because the farms are small and confine only small numbers of animals, the threat to environmental quality is minimal. The closer to residential areas the more meticulous the farmers are in handling waste. Public agencies seeking to maintain environmental quality should consider educational programs emphasizing the most acceptable practices for the average size livestock farm.
(White-Iowa State)

0327 - E3

RECYCLED POULTRY NUTRIENTS,
Michigan State Univ., East Lansing. Dept. of Poultry Science.
Howard C. Zindel.
Poultry Digest, Vol 30 (351), May 1971, p 231-233. 2 tab.

Descriptors: *Cycling nutrients, Farm wastes, Poultry, *Waste treatment, Waste disposal, Diets.
Identifiers: *Dried poultry waste, Recycled nutrients.

The text gives results of tests in which dehydrated poultry manure was incorporated into livestock feed. The feed was given to white leghorn chickens, beef cattle, sheep, dairy cattle, young calves, and goats. Tests on turkeys are just getting started. Three tests on chickens given control rations, 25% DPW (dehydrated poultry waste), and 12.5% DPW, gave the following results in production: 74.5%, 71.9%, 71.0% respectively. The conclusion is that the problem of smelly waste is eliminated, a valuable ingredient is gained which releases corn and corn protein for other world uses, the cost per dozen eggs or pound of gain is reduced, and an easy-to-handle fertilizer product (5-3-1), organic in nature and readily usable is obtained. (Hazen-Iowa State)

0328 - C5

EFFECTS OF CHLORTETRACYCLINE FEEDING ON BOVINE RUMEN MICROORGANISMS,
Washington State Coll., Pullman. Dept. of Bacteriology.
R. E. Hungate, D. W. Fletcher, and I. A. Dyer.
Journal of Animal Science, Vol 14, 1955, p 997-1002. 1 fig, 3 tab, 7 ref.

Descriptors: *Ruminants, *Feeds, Laboratory tests, Fermentation, Inhibition, Methane bacteria, Microorganisms, Pollutant identification, Water pollution effects.
Identifiers: Manometric experiments, Chlortetracycline feeding.

Manometric experiments of short duration were employed to measure the total fermentation products of rumen contents from chlortetracycline-fed and control animals, both in the presence and absence of additional chlotetracycline. Inhibition by added antibiotic was greater in the control animals, indicating that calortetracycline feeding had altered the composition of the rumen microbial population. Methane production was diminished by the added chlortetracycline but this was probably a secondary result from inhibition in the production of the intermediates, hydrogen and formate. The potential for microbial activity in the rumen contents from chlortetracycline-fed steers was about the same as in the controls. The rumen micro-organisms appear to be somewhat more sensitive to chlortetracycline than to streptomycin. (Hazen-Iowa State)

0329 - D2, F5

DISPOSAL OF HATCHERY WASTES,
Harrold's Hatchery, Inc., Winterville, Ga.
Tom Harrold.
Poultry Digest, Vol. 30 (351), May 1971, p 250-251.

Descriptors: *Waste disposal, *Poultry, *Waste treatment, Incineration, Temperature, Disposal.
Identifiers: *Hatchery waste disposal.

A description is given in this text of a method of waste disposal which reduces waste to 5% of the original and produces a product desired by gardeners. This method is incineration. Five design criteria are given in considering incinerators for use in disposal of hatchery wastes. They are (1) burning area; (2) operating temperature; (3) temperature control; (4) refractory materials; (5) stack. Maintenance of an incinerator is minimal and the incinerator produces no odor and no smoke. The powdery ash, composed mainly of calcium and magnesium, produced is in demand by gardeners. (Hazen-Iowa State)

0330 - C4, D4, E2

CONFINED SWINE MANURE DISPOSAL,
Kansas Univ., Lawrence. Dept. of Civil Engineering.
Robert A. Bella.
Master of Science Thesis, 1968. 157 p, 37 fig, 47 ref. OWRR Project A-011-KAN (2).

Descriptors: *Farm wastes, *Pigs, Aerobic conditions, Oxygen requirements, Waste water treatment, Biochemical oxygen demand, Chemical oxygen demand, Hydrogen ion concentration, Waste disposal.
Identifiers: *Swine wastes, *Oxidation ditch, Rotor capacity.

The object was the evaluation of an oxidation ditch for the treatment of swine manure. The oxidation ditch was constructed as part of the foundation for each building. Slotted floors permitted the manure to discharge directly from the animal into the treatment unit. Data were collected at weekly intervals from September, 1966 to August, 1967. The data indicated that the oxidation ditch could treat swine manure without odor nuisances. These units were able to reduce the soluble BOD to less than 10 milligrams per liter with a total effluent BOD of about 1,200 milligrams per liter. The effluent also contained considerable salts in addition to the suspended solids. It was necessary that the treated effluent be discharged into cultivated fields rather than being discharged into the adjacent drainage ditch. A holding pond was used to store the discharge of the treated effluent prior to spreading on nearby fields. (Miner-Iowa State)

0331 - B1, D4

DISPOSAL OF DAIRY MANURE,
Massachusetts Univ., Amherst. Dept. of Agricultural Engineering.
Curtis A. Johnson.
Transactions of the American Society of Agricultural Engineers, Vol 8, 1965, p 110-112. 3 fig, 11 ref.

Descriptors: *Farm wastes, *Cattle, *Septic tank, Poultry, Fertilizers, Economics, Aesthetics, Efficiencies, Dusts, Evaluation, Value, Lagoons, Water pollution, Odor, Pumps, Methane, Anaerobic digestion, Aeration, Effluent, Recirculated water, Irrigation, Aerobic treatment, Waste water treatment.
Identifiers: *Scraper, *Dairy cattle, Manure production, Effectiveness, Push-button operation, Potential, Fly production, Appearance, Noise, Aerobic pond, Decomposition, Population equivalents, Agitation.

Heated septic tanks, adapted to recirculation of effluent, hold promise for efficient fluid handling of manure and other dairy wastes with minimum labor costs and reasonable structural costs. Effluent from a three chambered, heated septic is pumped to manure gutters behind specially designed stalls. The effluent provides enough pressure to force a scraper the length of the gutter, thus pushing the accumulated manure to the septic tank. General design criteria are given. An evaluation scale is developed for qualitative evaluation of various manure handling systems. (White-Iowa State)

0332 - B2

HOW WE HANDLE LIQUID MANURE,
Hoard's Dairyman, Vol 109, November 25, 1965, p 1254-1255, 1280-1281. 14 fig, 1 tab.

Descriptors: *Farm waste, *Cattle, *Storage tanks, Slurry, Costs, Volume, Age, Construction, Moisture content, Odor, Pumps, Electric power, Impellers, Nutrients, Waste water treatment.
Identifiers: *Dairy cattle, *Liquid manure system, Free stall housing, Agitation, Tank spreader, Fly breeding.

Five top dairymen are interviewed about their liquid manure handling systems. All incorporated storage tanks, and disposal on land with tank spreaders. Different types of agitation and pumping methods are explained. The systems ranged in cost from $3250 to $7800, or from $35 to $52 per cow. This included storage tank, agitation and pumping equipment, and tank spreaders. Several spent up to $6600 for concreting the barnyards. The tanks varied in capacity from 18,000 to 75,000 gallons, and were emptied as often as once a week to once every two months. The need for added moisture is discussed as well as fly and odor problems. Some disadvantages are given, the major one being the high capital investment. (White-Iowa State)

0333 - D4

AEROBIC DIGESTION (COMPOSTING) OF POULTRY MANURE,
A. Livshutz.
World's Poultry Science Journal, Vol 20, 1964, p 212-215. 1 fig.

Descriptors: *Farm wastes, *Poultry, *Aerobic treatment, Aeration, Plastics, Plastic pipes, Width, Depth, Length, Volume, Pressure, Moisture, Temperature, Aerobic bacteria, Oxygen, Odor, Hydrogen ion concentration, Moisture content, Compaction, Waste water treatment.
Identifiers: *Composting, *Windrow method, Plastic sheets, Pressure blower, Forced-air system, Decomposition, Fly breeding, Carbon-nitrogen ratio, Oxidizing atmosphere.

The article describes a windrow method of cdmposting in which a pressure blower forces air through lateral 3/4 inch diameter pipes. The pipes have four rows of about 15 holes, each one to two mm. diameter. The windrow, up to 50 meters long and 3 meters wide, is covered with a plastic sheet. Nine advantages of the aeration system are given. The plastic covering may eliminate turning of windrows, by preventing the upper layers of the composting material from drying out. The carbon-nitrogen ratio should be around 25-30:1 with a pH of about 7. Optimum moisture should be about 50 per cent. After about two weeks of composting, depending on the material and climatic conditions, the manure is sterilized, odorless and dry and can be used profitably for agircultural purposes. (White-Iowa State)

0334 - D4

CHEMICAL AND BIOLOGICAL REACTIONS FROM LAGOONS USED FOR CATTLE,
Wisconsin Univ., Madison.
S. A. Witzel, Elizabeth McCoy, and Richard Lehner.
ASAE Paper No 64-417. Transactions of the American Society of Agricultural Engineers, Vol 8, p 449-451, 1965. 1 fig, 16 ref.

Descriptors: *Oxidation lagoons, *Biochemical oxygen demand, *Anaerobics, Algae, Bacteria, Water pollution sources, Odor, Farm waste, Sludge, Solid wastes, Decomposting organic matter, Lagoons, Cattle.
Identifiers: Organic nitrogen, Bacteriological study, Aerobicity.

An experimental lagoon to receive the wastes as liquid manure from six bulls was constructed. In an experimental barn the manure from the bulls was washed daily into two gutters 24 in. wide at the top. The gutters had a capacity of 2000 gallons. The gutters were flushed every seven days into a lagoon. The circular lagoon had a 60 ft diameter at the top, a 40 ft diameter at the bottom and was 5 ft deep. Liquid manure samples were taken from the barn gutter and from the lagoon manure liquid and sludge. BOD tests were conducted on all samples and the percent BOD reduction from gutter to lagoon was calculated. Other tests were made to determine percent total solids removal, organic nitrogen content, pH values, and temperature. Extensive tests were made and reported on bacteria content, both quantitative and qualitative. Five conclusions of the study are mentioned. (Parker-Iowa State)

0335 - B2, E1

EQUIPMENT FOR DISPOSAL OF AGRICULTURAL EFFLUENTS,
National Agricultural Advisory Service, London (England).
C. Culpin.
Chemistry and Industry, p 350-353, February 29, 1964. 3 ref.

Descriptors: *Farm wastes, *Disposal, Effluents, Slurries, Storage tanks, Silage, Distribution, Methane, Mixing, Distribution systems, Sprinkler irrigation, Pumps, Labor, Odor, Waste disposal, Waste water treatment.
Identifiers: Agitation, Vacuum pumping, Tanker.

Types and quantities of manure and other effluents are described, as well as systems and equipment for their disposal in Britain. Different storage methods and means of agitation or mixing are described. Four distribution systems are discussed. These include either some type of sprinkler irrigation or a tank wagon method. Labor requirements for both distribution methods, as well as future prospects are given. (White-Iowa State)

0336 - A6, A9, B2

DISPOSAL OF FARM EFFLUENT,
Ministry of Agriculture, Fisheries and Food, Norwich (England). Veterinary Investigation Center.
E. A. Gibson.
Agriculture, Vol 74, 1967, p 183-188.

Descriptors: *Slurries, *Farm wastes, *Salmonella, Cattle, Hogs, Infection, Incubation, Diseases, Gases, Hydrogen sulfide, Ammonia, Carriers, Waste water treatment, Waste disposal.
Identifiers: *Disease hazard, Anthrax, England, Johnes disease, Avian tuberculosis, Salmonella dublin, Salmonella typhimurium.

The possibility of spreading infection by the use of slurry manure disposal techniques is discussed. It is well known that many infections of farm live-stock are spread in their excreta. Little is known about the effects of such spread as slurry on the land, but under certain circumstances, the use of these systems could increase the disease hazard. Salmonella infection and Johnes disease are discussed in this respect, and anthrax and avian tuberculosis are mentioned more briefly. It is suggested that effluents thought to contain salmonella should not be put on the pasture or fodder crops that will be used for cattle or sheep within six months. The same precaution applies to Johnes disease, except that for cattle up to six months old, the period should be extended to twelve months. These figures may need to be revised as further knowledge and experience is gained. The non-infectious hazards to animal health include the liberation of toxic gases when slurry is agitated or emptied. (White-Iowa State)

0337 - B1, D1, E1, F1

A REVIEW OF POULTRY WASTE DISPOSAL POSSIBILITIES,
Ministry of Agriculture, Fisheries and Food, London (England).
C. T. Riley.
Water Pollution Control, Vol 67, No 6, p 627-631, 1968. 5 tab, 4 ref.

Descriptors: *Waste disposal, *Waste treatment, *Biochemical oxygen demand, *Costs, Waste identification, Drying, Land use, Aeration, Loading, Odor.
Identifiers: *Poultry waste disposal, *Bod/food intake relation, *Waste storage, *Chemical and physical properties (Waste), Heat drying, Nitrogen. Phosphorus, Potassium, Pasveer ditch, Bubble-gun installation, Processing stations (Poultry), Deep litter and broiler houses, Inedible by-products, Shock load.

Waste disposal problems in the poultry industry, contemporary poultry practice and related developments in agriculture are discussed, and trends considered. The main types of waste are analyzed; wastes from laying hens has higher NPK values than any other agricultural waste. A National Agricultural Advisory service (NAAS) survey emphasized the lack of knowledge, high cost of waste disposal to egg producers and social effects of the current tendency to increase livestock numbers and (due to transportation costs) to group production units near centers of consumption. Analysis is made of waste quantities and the chemical and physical properties of the waste. A reliable correlation appears to exist in BOD/food intake relationship. Settling difficulties in treatment are noted. The relationships between disposal practices and land uses are examined. The major problems arising from traditional methods of disposal are analyzed, especially the storage and heat drying phases. Traditional methods of sewage treatment no longer appear suitable for poultry wastes. The 'Pasveer ditch' or 'bubble-gun' type of installation may be more suitable; however, the high concentration of waste remains a problem. The treatment and disposal of wastes from deep litter and broiler houses is troublesome mainly if local accumulations become too large. This type of waste has the highest nitrogen content of all agricultural wastes. (D'Arezzo-Texas)

0338 - D4, E4

DIGESTION TESTS OF LIVESTOCK WASTES,
California Univ., Davis. Dept. of Agricultural Engineering.
Samuel A. Hart.
Journal of the Water Pollution Control Federation, Vol 35, No 6, June 1963, p 748-757. 7 fig, 2 tab, 11 ref.

Descriptors: *Farm wastes, *Poultry, *Cattle, *Sludge digestion, Stabilization, Hydrogen ion concentration, Alalinity, Biochemical oxygen demand, Chemical oxygen demand, Nitrogen, Carbon, Organic matter, Sewage, Odor, Gases, Waste water treatment.
Identifiers: *Dairy cattle, Volatile acids, Digesters, Gas production.

A laboratory test on the digestion of chicken and dairy manures indicates the following: (1) Both chicken and dairy manure would be stabilized satisfactorily in high-rate digesters equipped with adequate sludge-mixing equipment. (2) Dairy manure, because of its high lignin content, will effect organic matter destruction of only 10-15 percent. (3) The destruction of volatile matter expected from digesting chicken manure closely approximates that of municipal sludge digestion. (4) Operational parameters of pH, alkalinity, volatile acids, and the effect of temperature follow those expected for municipal sludge digestion. (5)Although nitrogen levels of chicken manure are high, digestion does not cause loss of nitrogen, but rather, through destruction of organic matter, it is concentrated to 8 or 9 per cent in the digested sludge. (6) BOD and COD are best expressed in terms of O2/mg VS for the high solids content of manures and manure sludges. (7) COD on a mg O2/mg VS basis increases upon digestion since digestion is a reducing reaction. (8) In total, digestion appears to have merit for stabilizing chicken manure. Consideration would still have to be given to final disposition since digestion does not destroy the waste. (White-Iowa State)

0339 - B2

FLUSHING AWAY MANURE PROBLEMS,
Hog Farm Management, Minneapolis, Minn.
Cliff Johnson.
Hog Farm Management, Vol 8, No 1, p 23-25 and 68, January 1971. 7 fig.

Descriptors: *Recirculated water, *Disposal, Farm wastes, Reclaimed water, Lagoons, Hogs, Odor, Labor, Waste water treatment.
Identifiers: *Flushing gutters, Oxidation ditches, Siphon mechanism, Swine, Collection, Automatic dosing siphon.

The flushing gutter system being experimented with at Iowa State University is described. Two variations of the flushing technique, one utilizing a solenoid flushing mechanism and the other a siphon mechanism, have been studied. In the first case, water fills an overhead tank which trips the solenoid causing a plug to lift and thus discharging the tank's contents. For the siphon system, a tank is fitted with 2 1/2 in. N-shaped trap pipe underneath. As the tank fills with water, enough water pressure is built up to force the tank's contents down the pipe into the gutter. The water is discharged rapidly (150 gal. in 62 sec.) through the 2 1/2 in. pipe. Because of the water's force as it is flushed, no dung is left in the gutter after flushing. The gutter is flushed three times per day. Advantages of the system include (1) reduced ventilation requirements, (2) less odor, (3) better feed efficiency, (4) no gas problem, and (5) no labor involved in manure removal. (Christenbury-Iowa State)

0340 - E3, F1

FERTILIZATION OF ANNUAL RANGELAND WITH CHICKEN MANURE,
California Univ., Riverside. Dept. of Agronomy.
Cyrus M. McKell, Victor W. Brown, Robert H. Adolph, and Cameron Duncan.
Journal of Range Management, Vol 23, p 336-340, 1970. 2 fig, 6 tab, 4 ref.

Descriptors: *Poultry, *Grasslands, *Farm wastes, Fertilizers, Costs, Range management, Cost-benefit analysis, Crop response, Phosphorus, California, Proteins, Waste water treatment.

Identifiers: *Chicken manure, Palatability, Rangeland fertilizer.

Where annual rangelands are close to the source of supply, fertilization with chicken manure appears to hold considerable promise in improving the production of forage for grazing. Fertilized polts were ready to be used earlier in forage of a higher quality and palatability. Protein and phosphorus were significantly higher in forage from fertilized plots. Fertilizer value of chicken manure is equal to equivalent rates of commercial fertilizer. There appears to be a slower release of fertilizer elements from chicken manure than from inorganic fertilizer. Annual forage legumes do not appear to benefit initially from the application of chicken manure. In subsequent years following fertilization, the legumes appear to thrive on the increased level of available phosphorus. It was profitable for rangeland operators to fertilize with poultry manure provided they could get it for $3.10 to $4.35 per ton applied. An average of 1,600 pounds of extra feed was obtained for each ton of manure. (Christenbury-Iowa State)

0341 - A3

AGRICULTURE AND THE PREVENTION OF RIVER POLLUTION, AS EXPERIENCED IN THE WEST OF SCOTLAND,
Clyde River Purification Board (Scotland).
F. J. Little.
Journal Proceedings of the Institute of Sewage Purification, 1966, p 452-454. 1 tab, 7 ref.

Descriptors: *Farm wastes, *Water pollution sources, Effluents, Cattle, Poultry, Hogs, Sheep, Rivers, Silage, Biological treatment, Waste water treatment.
Identifiers: *Scotland, Dairy cattle, Silage liquor, Sheep dips, Remedial action, Extended aeration, Rivers (Scotland) Act 1951.

Different types of polluting effluents in Scotland are discussed, and what action has been taken to prevent river pollution. Agricultural effluents can be divided into three groups - animal, vegetable, and chemical, of which animal effluents pose the greatest problem. Dairy waste is the most prevalent effluent, while beef, sheep, hogs and poultry play a minor role. Biological treatment here is in the experimental stage. Silage liquor has presented a problem due to its high BOD. Chemical effluents result from the use of sheep dips, herbicides, fertilizers, bactericides, and dairy detergents. Problems arise from careless use of equipment rather than intentional discharges. The problems of disposal are complex and require the patience and understanding of both farmer and the general public. A discussion follows the paper. (White-Iowa State)

0342 - C5

IN VITRO DIGESTIBILITY OF CHEMICALLY-TREATED FECES,
Department of Agriculture, Beltsville, Md. Animal Science Research Div.
L. W. Smith, H. K. Goering, and C. H. Gordon.
Journal of Animal Science, Vol 31, No 6, p 1205-1209, December 1970. 4 tab, 16 ref.

Descriptors: *Digestion, *Chemical degradation, Farm wastes, Ruminants, Fermentation, Cellulose, Costs, Alkalis, Waste treatment.
Identifiers: *Chemically-treated feces, Cell wall, Microbial responses, Oxidants.

Chemical treatment is a means for enhancing the digestibility of the indigestible plant cell wall residues in ruminant feces. Enhanced digestibility was ascertained with detergent solubility methods and in vitro rumen fermentation were obtained through dried chemical degradation of meicellulose, cellulose, and lignin and also through increasing the accessibility of the remaining cell wall for ruminal microbial fermentation. Chemical treatment of indigestible alfalfa or sudax fecal cell walls resulted in greater than 90% digestion (chemical degradation and microbial digestion). This experiment was designed to point out some of the conditions required for maximum chemical hydrolysis and maximum cell wall utilization. Whether or not these conditions can be approximated in feeding trials remains to be demonstrated. (Christenbury-Iowa State)

0343 - A2, A9

BOVINE SALMONELLOSIS (S. TYHIMURIUM) IN A FEEDLOT OPERATION,
W. C. Oglesby.
Veterinary Medicine/Small Animal Clinician, Vol 59, p 172-174, February 1964. 4 ref.

Descriptors: *Salmonella, *Cattle, Antibiotics, Temperature, Animal diseases, Stagnant water, Mud, Waste treatment, Diseases, Public health, Water pollution effects.
Identifiers: *Feedlot, Diarrhea, Salmonella typhimurium, Necropsy, Medication, Nitrofurazone.

An epizootic of a severe respiratory-enteric syndrome appeared in a feedlot operation of 1,000 head of cattle. Salmonella typhimurium was isolated from the organs of 5 carcasses, 3 fecal specimens, and from mud in a waterhole from which the animals drank. Correction of hygienic conditions, electrolyte supplementation, sulfathiazole medication in the drinking water, and intravenous antibiotics gave only mediocre response. Individual dosing with a nitrofurazone preparation and addition of nitrofurazone to drinking water was successful in eradicating the disease. (White-Iowa State)

0344 - B2, B3, F1

THE COLLECTION OF MANURE FROM HOUSED LIVESTOCK,
West of Scotland Agricultural Coll., Glasgow (Scotland). Dept. of Farm Buildings.
R. J. Forsyth.
Journal and Proceedings of the Institution of Agricultural Engineers, Vol 21, p 129-133, 1965.

Descriptors: *Farm wastes, *Cattle, Water pollution control, Sludge, Storage capacity, Storage tanks, Waste dilution, Construction materials, Costs, Slurries, Sluice gates, Electric power costs, Rotors, Waste water treatment.
Identifiers: *Dairy cattle, *Oxidation ditch, Slatted floors.

The paper describes collection and handling methods for dairy manure in Scotland. Parlor systems are scarce because of their large bedding requirement. Slatted floors in conjunction with free housing systems has proven highly satisfactory. Different slat types are discussed and evaluated. Under slat tanks or channels are described as well as criteria for dilution, storage capacity, and sluice gates. The possibility of using the Pasveer oxidation ditch is introduced as a result of stringent pollution regulation. Design and costs for the oxidation ditch are presented. A discussion follows the paper. (White-Iowa State)

0345 - A3, A9

BOVINE SALMONELLOSIS ASSOCIATED WITH CONTAMINATED CREEK WATER AND HUMAN INFECTION,
Kansas State Univ., Manhattan. Coll. of Veterinary Medicine.
C. M. Hibbs, and V. D. Foltz.
Veterinary Medicine/Small Animal Clinician, Vol 59, p 1153-1155, November 1964. 6 ref.

Descriptors: *Sewage, *Salmonella, Cattle, Sewage bacteria, Water pollution effects, Streams, Infection, Public health, Diseases, Waste treatment.
Identifiers: Human infection, Nicropsy, Diarrhea, Salmonella typhimurium, Bacteriologic examination, Water samples.

A case of Salmonellosis in calves, which may have been associated with human infection, is discussed. Salmonella typhimurium was isolated from two calves, creek water and one human. Though the origin of the infection was not specifically determined, the findings indicated that untreated house sewage may have been the source. The seriousness of water pollution and some of its ramifications are evident. An education program on water pollution is recommended. (White-Iowa State)

0346 - D4

LAGOONS FOR LIVESTOCK MANURE,
California Univ., Davis.
Samuel A. Hart, and Marvin E. Turner.
Journal Water Pollution Control Federation, Vol 37, No 11, November 1965, p 1578-1596. 5 tab, 6 fig, 9 ref.

Descriptors: *Farm wastes, *Poultry, *Cattle, *Hogs, *Lagoons, Stabilization, Biochemical oxygen demand, Anaerobic conditions, Sewage, Aerobic conditions, Odors, Volume, Sludge, Nitrogen, Phosphorus, Potassium, Chemical oxygen demand, Ammonia, Physical characteristics, Chemical characteristics, Hydrogen ion concentration, Alkalinity, Scum, Color, Opacity, Earth-water interfaces, Infiltration, Anaerobic digestion, Waste water treatment.
Identifiers: *Loading rates, *Physical appearance, Surface area, Total solids, Volatile solids, Volatile acids, Fly activity, Crusting, Pilot lagoons, Materials balance, BOD reduction, Sludge seed.

The need for more closely controlled tests of a laboratory type concerning livestock manure lagoons prompted this study. Eight concrete ringed pilot lagoons four feet in diameter and seven feet were used in the experiment. The units were fed poultry, dairy and cattle manure during the two year test. Chemical and physical properties were monitored weekly and are presented in tabular form. Infiltration from the packed earth bottom was considerable. This hampered the accurate determinations needed for a materials balance. Appearance, odors, and fly activity were noted. A section tells how to use the knowledge gained from the experiment. It is felt that with proper construction, property loading rates, and proper operation, lagoons can be expected to be satisfactory. (White-Iowa State)

0347 - D4

AEROBIC PURIFICATION OF FARM WASTE,
Rijkszuivel Agrarische Afvalwater Dienst, Arnhem (Netherlands).
H. M. J. Scheltinga.
Journal Proceedings of the Institution of Sewage Purification, p 585-588, 1966. 1 fig, 4 tab, 11 ref.

Descriptors: *Farm wastes, *Hogs, *Biological treatment, Anaerobic digestion, Activated sludge, Rotors, Nitrogen, Biochemical oxygen demand, Chemical oxygen demand, Foaming, Nitrification, Costs, Effluent, Laboratory tests, Ammonia, Waste water treatment.
Identifiers: *Oxidation ditch, Loading rates, Retention time.

Model tests, laboratory investigations, and finally a full scale field experiment with oxidation ditches were carried out in Holland, where an effective and economical waste treatment system is being sought. A 50 per cent BOD reduction was obtained using anaerobic decomposition in the laboratory. Initial and final characteristics of the pig waste are given before and after treatment in the oxidation ditch. Foaming was excessive from the start. Nitrification played an important part in eliminating the ammonia. Total and expected operational costs are given. (White-Iowa State)

0348 — A8, B3

BIOLOGICAL FLY CONTROL IN DEEP PITS,

Poultry Digest, p. 25, January 1971.

Descriptors: *Poultry, *biological treatment, farm wastes, disposal.
Identifiers: *Fly control, fly breeding, deep pit.

Though fly control is one of the reasons for building deep pit poultry houses, some operators have had serious fly problems when houses were put into operation. Later, if the manure is not too wet, parasites and predators that are natural enemies of flies become established. "Flies were noticeably less of a problem in many deep pit cage houses this past year," observed 'Maine's Timely Topics' for November, 1970. "Flies have been controlled with sprays and/or baits. However, many deep pit cage house owners got by last summer with little or no spraying. In all cases, the houses were two, three or more years old." When it becomes necessary to remove manure, a partial cleanout is preferable. Leave behind some of the fly's natural enemies. (Christenbury-Iowa State).

0349 — B1, E2

MAXI-MIXING FOR MANURE DISPOSAL,

Poultry Digest, p. 12, January 1971.

Descriptors: *Disposal, farm wastes, poultry, pollution.
Identifiers: *Composting, Maxi-mixing.

When a Connecticut poultryman was confronted with a large quantity of manure and small acreage, he mixed soil into the manure with a bulldozer. The result was a composted mixture in a few months, according the Connecticut in a few months, according to the Connecticut Poultry Notes. Maxi-mixing is the term used to describe this disposal system using a maximum amount of soil. Monitoring and further research are being conducted to establish limits before pollution and plant toxicity occur. Heavy application of animal manure to land can cause nitrate and nitrite levels in water high enough to be hazardous to humans and ruminants. (Christenbury-Iowa State)

0350 — A5, A8, B1, C5

SCHEDULE MANURE REMOVAL TO AVOID FLY BREEDING,

'California University, Riverside.
Robert H. Adolph.
Poultry Digest, p. 29, January 1971.

Descriptors: *Farm wastes, *poultry, California, anaerobic conditions, odors.
Identifiers: *Fly breeding.

Because January to June in California is the peak period for fly breeding, Dr. Andrew Deal, University of California, Riverside, advises against removal of manure from poultry houses during that time, You are much better protected from fly breeding buildup if the manure can be kept dry. Wet manure is conducive to fly breeding and the generation of putrid odors. (Christenbury-Iowa State).

0351 - B2

DAIRY SET-UP FOR 200 COWS,

Guy Faulkner.
Power Farming, p 38-39, Jan 1970. 6 fig.

Descriptors: *Farm wastes, Lagoons, Slurries, Cattle, Hogs, Silage, Cereal crops, Costs, Waste water treatment, *Oxidation lagoons.
Identifiers: *Dairy cattle, *Evaporative lagoon, Free stall housing, Milking parlor, Farrowing houses, Collecting yard.

The article describes the layout and features of a newly developed dairy operation for 200 cows. Features include three 120 feet long steel framed loafing barns and a 100,000 cu. ft. capacity evaporative lagoon. The solidified contents of the lagoon will be dug out by a contractor in summer. A 200 sow pig unit has also been established on this 500 acre Sussex farm. (White-Iowa State)

0352 - A2, B1, E1

DISPOSAL OF WASTES FROM SWINE FEEDING FLOORS TO MINIMIZE STREAM POLLUTION,

Maryland Univ., College Park. Dept. of Agricultural Engineering.
W. F. Schwiesow, H. L. Brodie, and H. J. Eby.
Completion Report, University of Maryland, Water Resources Research Center, January 1970. 11 p. OWRR Project A-004-MD (1).

Descriptors: *Farm wastes, *Water pollution sources, *Pigs, *Septic tanks, Digestion tanks, Sedimentation tanks, Soil disposal fields, *Waste disposal, Waste water treatment.
Identifiers: *Flushing gutters, Swine manure.

This research was to investigate the feasibility of a septic disposal system with an underground distribution system as a means of eliminating runoff from swine feeding floors into the surface waters. Installation provided for hydraulic cleaning of the feeding floor. Manure, water and uneaten feed was washed into gutters, one on each side of the house. Modifications included the addition of a 7,000 gallon tank, a 1,200 gallon tank and connecting 4 inch PVC pipe. Six hundred feet of perforated plastic drain lines were located near the tanks. It was soon evident that the large tank intended to serve as a septic tank was inadequate and performed primarily as a sedimentation tank. Data taken showed this tank was satisfactory for accumulating solid wastes for a period of about 5 weeks. Solids were removed by mechanical means. Tests on the tile distribution system showed that the capacity to dispose of the liquid effluent was more than needed. Proper operation should provide a satisfactory means of disposing of the liquid portion of the wastes without polluting the nearby river. (Miner-Iowa State)

0353 - C1, D4

OXIDATION DITCH TREATMENT OF SWINE WASTES, SUMMARY REPORT,

Illinois Univ., Urbana.
D. L. Day, D. D. Jones, J. C. Converse, A. H. Jensen, and E. L. Hansen.
American Society of Agricultural Engineers, Paper No. 69-924. 16 p, 1 tab, 9 fig, 24 ref. Bureau of Solid Waste Management Research Grant No. EC-00245-03, also Reg Res Proj NC-69.

Descriptors: *Farm wastes, *Waste water treatment, Hogs, Slurries, Odors, Livestock, Effluents, Mechanical equipment, Protozoae, Biochemical oxygen demand, Chemical oxygen demand, Farm lagoons, Sludge, Aerobic treatment, Biological treatment, Liquid wastes, Laboratory tests, Design criteria, *Oxidation lagoons.
Identifiers: Oxidation ditches, Pasveer oxidation ditch, Slotted floor, Livestock buildings, Ciliated protozoan, Swine, Oxygenation capacity, Loading rates, Field tests.

Swine wastes research for the three-year period beginning September 1, 1966 is summarized. Upon finding that swine manure could be aerobically treated, a modification of the Pasveer oxidation ditch was tested. The in-the-building oxidation ditch has proven itself in the field as capable not only of eliminating objectionable odors from manure pits but of reducing the BOD5 pollutional value of the waste by about 90 percent. The volatile solids can also be reduced by about 50 percent. Even so, the mixed liquor should not be discharged directly into a stream. There will, however, be surplus water and sludge to be disposed of, as with any other waste-treatment system. Operating the ditch with a constant liquid depth and a constant rotor immersion depth is recommended for operator convenience. This can be done by using an overflow. Having the mixed liquor overflow into an aerobic lagoon is also in keeping with operator convenience and low labor requirements. The lagoon can have a fluctuating depth, so that surplus water and sludge can be removed at a convenient time. The simplest method is by using irrigating equipment. (Christenbury-Iowa State)

0354 - A9

SALMONELLOSIS IN CATTLE,

Ministry of Agriculture, Fisheries and Food, Norwich (England). Veterinary Investigation Center.
E. A. Gibson.
Agriculture, Vol 73, 1966, p 213-216.

Descriptors: *Farm wastes, *Cattle, *Salmonella, Pathogenic bacteria, Infection, Bacteria, Carriers, Disinfection, Water treatment.
Identifiers: *Salmonella dublin, *Salmonella tyhimurium, Calves, Illness, England, Clinical signs, Vaccine, Prevention, Outbreaks.

The article describes the diagnosis, treatment, clinical signs, and prevention of salmonella in cattle. Though usually a disease causing calf losses it can affect adult cattle too. Under British conditions two main organisms are responsible. These are S. dublin which is essentially a pathogen of cattle, and S. typhimurium which seems able to infect all species of birds, animals, and man with equal facility. Recommendations are made for the disinfection and prevention of the disease. (White-Iowa State)

0355 - B1, C1, D4, F1

FARM WASTES,

Netherlands Government Agricultural Waste Water Inst., Arnhem.
H. M. J. Scheltinga.
Water Pollution Control, Vol 68, No 4, p 403-413, July-August, 1969. 3 fig, 2 tab, 5 ref.

Descriptors: *Farm wastes, *Activated sludge, *Aerobic treatment, Water pollution, Extended aeration, Fertilizers, Biochemical oxygen demand.
Identifiers: *Oxidation ditch.

Manure in modern automated animal houses is often collected by falling through slatted floors into a channel. The final waste is a slurry and has little value. Volume, dry matter, BOD, and total N values are listed for man, cow, calf, sheep, pig, and hen wastes. Anaerobic manure storage results in 50% BOD reduction. The usual disposal method is using a fertilizer, but there must be a demand within a reasonable distance. Volume reduction methods are: treat the slurry liquid portion separately; or dewater the slurry mechanically or thermally. Treatment by oxidation ditch is discussed. Average effluent figures, in mg/l, are: COD, 100-1000; BOD, 10-100; NH3, 5-50; NO2, 0-50; NO3, 10-200; pH, 6.5-8.5. Oxygen concentration is important; and OC: load ratio of 2 is suggested for design. There was a 40-50% NH3 and total N reduction when air was bubbled thru a pig waste, but no reduction occurred in a similar waste which has been poisoned with C (++). It was concluded that mechanical ammonia stripping does not eliminate nitrogen compounds. Oxidation ditch construction is discussed. Costs of alternative disposal methods such as transportation to farm land or artificial drying must be considered when deciding which to use on oxidation ditch. (Steiner-Texas)

0356 — B2, E2

FURROW MANURE DISPOSAL,

Rutgers University, Agricultural Engineering Department.
Charles H. Reed.
Poultry Digest, Vol. 24, 1965, p. 278, 1 fig.

Descriptors: *Farm wastes, *poultry, furrows, rates of application, disposal, chutes.

Identifiers: *Tank trailer, capacity, plow, solids content, plow furrow cover, auger agitator.

The author reports on a research project to explore the feasibility of disposing of poultry manure in plowed furrows. A 750 gallon tank trailer was equipped with an auger agitator operated by an engine, and a center rear spreader and chute. The chute was changed to the front so the operator could see and control the amount of poultry manure, at 22% solids, deposited in the bottom of a furrow. Further refinement resulted in pulling the trailer behind a single oottom mounted plow. This achieved the objective of depositing the manure in a previously plowed furrow - covering the manure and opening the next furrow in one operation. At present a scheme is being devised to mount the plow on the tank trailer. (White-Iowa State).

0357 - B1
MECHANICAL CLEANING OF COWSHEDS,
Agricultural Land Service, Leeds (England).
J. N. Addison.
Agriculture, Vol 77, No 11, November 1970, p 534-536.

Descriptors: *Farm wastes, Cattle, On-site data collection, Age, Costs, Specifications, Depth, Width, Length, Slopes, Ponding, Maintenance, Waste water treatment.
Identifiers: *Dairy cattle, *Mechanical cleaners, *England, Continuous type, Shuttle type, Cow sheds, Blades.

Twenty-one cowsheds on eighteen farms were surveyed to establish the extent to which mechanical channel cleaners had been installed, their age, condition, costs, and reasons for their installation in the first place. Problems with the mechanical cleaners are discussed as well as design specifications. The cost per cow of the shuttle type cleaner was found to be about 21 pounds and that of the continuous type 18 pounds. (White-Iowa State)

0358 - C2, C3, D1
TREATMENT OF FARM EFFLUENTS,
Water Pollution Research Lab., Stevenage (England).
A. B. Wheatland, and B. J. Borne.
Chemistry and Industry, February 29, 1964, p 357-362. 5 tab, 7 ref.

Descriptors: *Farm wastes, *Cattle, *Hogs, *Waste water treatment, Surface runoff, Volume, Water pollution, Biochemical oxygen demand, Cooling water, Carbon, Nitrogen, Nitrate, Effluents, Sewage, Filtration, Irrigation, Farm ponds, Silage, Organic matter, Biological treatment, Septic tanks.
Identifiers: *England, *Dairy cattle, Pollutional strength, Milking parlors, Permanganate, Recirculation, Land disposal, Soakaways, Chemical treatment.

Sources, volumes, and strength characteristics of farm effluents are discussed. A major portion deals with dairy and waste water effluents, coming from milking parlors and holding pens. Chemical and physical properties are listed in tabular form. Hog wastes and silage liquor are mentioned briefly as effluent sources. Treatment methods discussed include disposal on land, discharge to a sewer, biological treatment, septic tanks and chemical treatment. Disposal on land may be accomplished by use of tankers, soakaways, or irrigation. The use of storage ponds facilitates the latter. (White-Iowa State)

0359 - B2, D4, F1
WHIPPING THE MANURE PROBLEM,
Alan Linn.
Farm Quarterly, Winter 1966-1967, p 56-59, 115-116. 4 fig, 2 tab.

Descriptors: *Farm wastes, *Hogs, *Oxidation, *Aerobic bacteria, Labor, Odor, Fertilizer, Value, Organic matter, Carbon dioxide, Water, Nitrogen, Ammonia, Nitrites, Nitrates, Phosphorus, Potassium, Hydrogen sulfide, Methane, Anaerobic bacteria, Aeration, Design standards, Volume, depth, Foaming, Dispersion, Costs, Submergence, Biochemical oxygen demand, Oxygen, Temperature, Waste water treatment.
Identifiers: *Oxidation ditch, *Paddle wheels, Agitation, Circulation, Batch system, Continuous system, Paddle wheel diameter, Slatted floors.

The oxidation ditch is described as an important new breakthrough in manure handling. Advantages of the oxidation ditch include savings in labor, handling manure as a liquid, elemination of almost all odor, and the preservation and concentration of fertilizer nutrients. Basic design standards are given for the ditch and paddle wheel. If the ditch is managed on a continuous basis, 1 1/2 percent of the ditch volume can be added as manure daily. General management requirements and costs are included. The paddle wheel with a 1 1/2 to 3-hp motor costs about $600. The ditch walls can be incorporated into the building's foundation. Estimated power costs are about $1.00 per hog and $8.20 per 1000 pound dairy cow per year. Many changes in confined livestock production through use of the oxidation ditch are contemplated. (White-Iowa State)

0360 - C4, D4
THE BACTERIAL POPULATION OF AN INDOOR POULTRY LAGOON,
Louisiana State Univ., Baton Rouge. Agricultural Experiment Station; and Louisiana State Univ., Baton Rouge. Dept. of Microbiology; and Louisiana State Univ., Baton Rouge. Dept. of Agricultural Engineering; and Louisiana State Univ., Baton Rouge. Dept. of Poultry Science.
Leon J. Cabes, Jr., Arthur R. Colmer, Harold T. Barr, and Benjamin A. Tower.
Poultry Science, Vol 48, No 1, p 54-63, 1969. 2 fig, 3 tab, 17 ref.

Descriptors: *Farm wastes, *Poultry, *Oxidation lagoon, Microorganisms, E. coli, Aeration, Sampling, Coliforms, Bacteria, Pathogenic bacteria, Temperature, Hydrogen ion concentration, Biochemical oxygen demand, Aerobic bacteria, Waste water treatment.
Identifiers: *Laying house, *Bacterial counts, Enterococci, Suspended solids, Manometric studies.

The study was concerned, first, with the enumeration, isolation, and classification of the predominant bacterial flora of an indoor poultry waste stabilization lagoon, and secondly, with an evaluation of this flora to determine the organisms most active in the degradation process. The lagoon consisted of a pit 3 feet 6 inches deep x 13 feet wide x 88 feet long inside a laying house which measured 14 feet x 100 feet. The standard plate counts of aerobic organisms present in the waste water of the lagoon are presented in tabular form. Total solids, pH and BOD reduction data are also presented. The lagoon was aerated with 200 feet of perforated pipe which feed 4 cfm of air at 15 psi. It is felt that additional modifications might be instituted. (White-Iowa State)

0361 - E3
NUTRITIVE VALUE OF OXIDATION-DITCH RESIDUE,
Illinois Univ., Urbana.
B. G. Harmon, A. H. Jenser, and D. H. Baker.
Journal of Animal Science, Vol 29, No 1, p 136, July 1969.

Descriptors: *Nutrients, Farm waste, Feeds, Value, Aerobic treatment, Diets, Amino acids, Energy, Waste water treatment.
Identifiers: *Excreta, *Swine, Feed value, Oxidation-ditch, Rats.

Swine excreta suspended in water and adjutated to promote aerobic digestion was studied as a source of nutrients. In four growth trials 132 weanling rats were used to study the nutritive value of amino acids and energy contained in the oxidation-ditch residue (ODR). The digestible energy decreased linearly as ODR was added to the diet. (Christenbury-Iowa State)

0362 - C4
DISTRIBUTION OF BACTERIA IN FECES OF SWINE,
Missouri Univ., Columbia.
Gloria D. Rall, Arletta J. Wood, R. B. Wescott, and A. R. Dommert.
Applied Microbiology, Vol 20, No 5, p 789-792, Nov 1970. 3 tab, 2 fig, 12 ref. Public Health Service grants RR-00390 and RR-00285.

Descriptors: *Bacteria, *Distribution, Farm wastes, Patterns, Microorganisms, Pollutant identification.
Identifiers: *Fecal samples, *Swine, Frequency, Distribution.

A new technique is described for evaluating bacterial cell distribution in fecal samples. Spatial relationships of cells within an area rather than number of cells per unit volume or weight are measured by this technique. Measurements of cell distribution by this method indicated that bacteria occurred in freshly voided swine feces as pure, discrete colonies rather than as single cells distributed randomly or uniformly throught the sample. (Christenbury-Iowa State)

0363 - C2, C3, A5
ODOR TRANSPORT BY PARTICULATE MATTER IN HIGH DENSITY POULTRY HOUSES,
Cornell Univ., Ithaca, N.Y. Dept. of Food Science.
William E. Burnett.
Poultry Science, Vol 48, No 1, p 182-185, 1969. 1 fig, 1 tab, 9 ref.

Descriptors: *Farm wastes, *Poultry, *Odor, Gas chromatography, Volumetric analysis, Volume, Filters, Nitrogen, Organoleptic properties, Ventilation, Pollutant identification, Air pollution, Pollution abatement.
Identifiers: *Particulate matter, Odor transport, Odor panel, Volatiles, Concentrations, Odoriferous components.

The report investigates the concentrations of airborne particulate matter in a high density poultry house and the role of particulate matter as an odor transport mechanism. Particulate matter collected by high volume samplings, of a commercial poultry house atmosphere revealed that the particulates had a 'chicken house' odor. Gas chromatographic analyses of the volatiles carried by the particulates revealed the presence of a number of individually odoriferous compounds. Large quantities of particulate matter are probably expelled from poultry houses by ventilation fans. Whether particulate matter plays a significant role in ambient odors from poultry houses should be investigated since the particulates represent a retentive source of odors. (White-Iowa State)

0364 - D2
LOSSES OF ENERGY AND NITROGEN ON DRYING POULTRY EXCRETA,
Queen's Univ., Belfast (Northern Ireland). Dept. of Agricultural Chemistry.
D. W. F. Shannon, and W. O. Brown.
Poultry Science, Vol 48, p 41-43, 1969. 1 tab, 3 ref.

Descriptors: *Farm wastes, *Poultry, Energy, Nitrogen, Drying, Freeze drying, Vacuum drying, Forced drying, Temperature, Waste treatment.
Identifiers: Kjeldahl nitrogen, Metabolizable energy, Dry matter.

Losses of energy and nitrogen were determined from samples of fresh excreta differing in dry matter and nitrogen content. The samples were dried under the following conditions - freeze drying, vacuum drying at 40C and drying in forced-air ovens at 60C, 100C, and 120C. Nitrogen of the undried and dried excreta was determined by the conventional Kjeldahl method. The mean results of ten energy determinations (%) on fresh excreta samples A and B were 804, 753, 2.51 respectively. The energy losses are in agreement with other authors. From the results of the experiment, the drying temperature should be chosen depending on whether the energy or nitrogen content is more important. In the determination of metabolizable energy, then the method giving lower energy errors would be used. (White-Iowa State)

0365 - A1, F4

AGRICULTURE FACES NEW CHALLANGES IN CURRENT ENVIRONMENTAL CRISES,
Department of Agriculture, Washington, D.C. Science and Education.
Ned D. Bayley.
Water and Wastes Engineering, Vol 7, No 11, p F-14 - F-16, November 1970. 4 fig.

Descriptors: Farm wastes, Water, Water resources, Pesticides, Salinity, Sediments, Water pollution control, Fertilizers, Planning.
Identifiers: Soil spoiler.

The responsibility of agriculture in enhancing the quality of the environment is colossal. This is because agriculture, including forestry, involves more natural resources than any other segment of society. Wise planning in the use of land, water, chemicals, and waste disposal techniques must be demanded, and it must be done now. This paper outlines some of the problems and difficulties encountered in dealing with agricultural pollutants. (Christenbury-Iowa State)

0366 - B2, D4, E2

LIQUID HANDLING OF POULTRY MANURE,
Massachusetts Univ., Amherst. Dept. of Agricultural Engineering.
Curtis A. Johnson.
ASAE Paper No NA 64-501. Transactions of the American Society of Agricultural Engineers, Vol 8, p 124-126, 1965. 2 fig, 1 tab, 6 ref.

Descriptors: *Liquid waste, *Order, *Septic tanks, *Water reuse, Farm waste, Sludge disposal, Poultry, Ammonia, Disposal, Design criteria, Cost comparisons, Effluents, Waste water treatment.
Identifiers: *Recycling, Liquid-manure handling, Ammonia odor, Congdon system.

This article describes an integrated system concept for liquid manure handling of waste produced by laying hens in conventional commercial cage units. The bird droppings in this unit collect in 8 inch deep, 44 inch wide troughs formed on original floor with 4 inch thick concrete blocks. The lower end of each sloped trough is closed with a 2 inch x 6 inch board. These boards are removed to empty the troughs into a 24 inch by 24 inch trench running across the end of the building below floor level. This sloping trench empites into a 12 inch diameter plastic pipe which conveys the waste to an underground septic tank. From the third compartment of this three-compartment tank the effluent is pumped back into the laying house to hydraulically clean the troughs beneath the cages. The effluent becomes increasingly concentrated. The effluent is periodically pumped onto forest land and the sludge is 'batch' handled. This manure system provides: (1) Easy manure handling, (2) Few moving parts, (3) Little ammonia odor, (4) Low water usage, (5) Simple manure disposal, (6) Low-cost pit cleaning. (Parker-Iowa State)

0367 - C3, C5

NITROGEN AND AMINO ACIDS IN THE FECES OF YOUNG PIGS RECEIVING A PROTEIN-FREE DIET AND DIETS CONTAINING GRADED LEVELS OF SOYBEAN OIL MEAL OR CASEIN,
Guelph Univ. (Ontario). Dept. of Nutrition.
Kathleen H. Carlson, and H. S. Bayley.
Journal of Nutrition, Vol 100, No 11, p 1353-1361, 1970. 5 tab, 3 fig, 17 ref.

Descriptors: *Nitrogen, *Amino acids, *Proteins, *Diets, Farm wastes, Hogs, Water pollution sources.
Identifiers: Young pigs, Protein-free diets, Casein, Soybean oil meal.

Thirty-two piglets were weaned at 14 days of age and received a nutritionally complete diet; at 20 days of age they were allocated to either a protein-free diet, or diets containing 7, 14, or 21% protein from either soybean oil meal or casein. Feed consumed between 21 and 31 days of age was measured and the feces voided were collected. The n-butyl-N-trifluoroacetyl esters of the amino acids in hydrolysates of feed and feces were separated by gas-liquid chromatography. The amounts of fecal nitrogen and of each of the 13 amino acids of metabolic origin were calculated directly from the observations made on the protein-free diet and indirectly by regression analyses of the outputs of the piglets receiving the diets containing graded levels of protein. The metabolic fecal nitrogen excretion determined directly (111 mg. N.100 g. feed consumed) agreed more closely with other published values than the indirect estimates obtained by regressions. The direct values were used in calculating the corrected digestibilities of the nitrogen and of the amino acids in the two protein sources. The corrected digestibilities of the nitrogen and amino acids in the casein were very high (97 - 100%), but were lower for the soybean meal. There were significant differences in the corrected digestibilities of the individual amino acids in the soybean oil meal, which ranged from 82% for alanine to 93% for glutamic acid. The level of inclusion of casein did not influence the corrected digestibilities of the amino acids, but increasing the level of soybean oil meal in the diet caused a significant reduction in the corrected digestibilities of isoleucine, leucine and proline. (Christenbury-Iowa State)

0368 - B1, E1

AGRICULTURE WASTE RESEARCH NEEDS,
Cloisterdale Farms, Ephrata, Pa.
Glenn H. Herr.
Compost Science, Journal of Waste Recycling, Vol 11, No 5, Sept-Oct 1970, p [illegible] 4 fig.

Descriptors: *Farm waste, *Poultry, *Disposal, *Drying, Odor, Costs, Equipment, Aeration, Lagoons, Irrigation, Waste water treatment.
Identifiers: SHUD, Neighbors.

The author is responsible for disposal of 17,000 plus or minus tons of raw waste annually from a laying hen complex of 360,000 hens. Their problems incidental to poultry 'SHUD' were: first - volume accumulation of shud within houses, second - community relations - odor primarily; danger of soil and water pollution secondarily. Third - ultimate disposal, and, finally fourth - the unknown factor of the possibility of, or the effect of, gas toxicity to the chickens and humans. Some of their attempted and/or considered methods for disposal were the use of: (1) lagoons; (2) irrigation; (3) sewage treatment plant; (4) incineration; (5) burying; (6) hauling and spreading; future consideration: (7) semidrying; (8) possible dehydration - which might lead to: fertilizer products; re-feeding; or some other uses. Their conclusion was that liquid handling would not be the long range answer to their problems. They concluded that some method of dry or semi-dry procedure must develop as their solution and as an industry solution. Mr. Herr describes the system of drying the manure in place and the cost of disposal of the simi-dried (30%) SHUD. (Christenbury-Iowa State)

0369 - D4

ANAEROBIC DECOMPOSITION OF SWINE EXCREMENT,
Nebraska Univ., Lincoln. Dept. of Agricultural Engineering.
O. E. Cross, and Alvaro Duran.
Nebraska Agricultural Experiment Station Journal Paper No 2531. Transactions of the ASAE, Vol 13, No 3, May 1970, p 320-322. 11 fig, 7 ref.

Descriptors: *Farm wastes, Laboratory tests, *Anaerobic digestion, *Hogs, Anaerobic conditions, Temperature, Sludge, Biochemical oxygen demand, Hydrogen ion concentration, Waste water treatment.
Identifiers: Swine, Loading rates, Volatile solids, Detention times, Digesters.

This paper presents a laboratory analysis on the anaerobic digestion of swine excrement as affected by temperature and loading rate. The tests were run for 15 days. The experiments were conducted using ambient temperatures of 50, 70, and 90 F. at three loading rates. The loading rates were 3.2, 1.6, and 0.8 g. of volatile solids per liter of digester volume per day. Volatile-solids content was determined daily during a 15-day test period. Moisture content, total solids, fixed solids and pH were also determined daily. A 5-day BOD test was performed. None of the experiments reached equilibrium; however, it was possible to detect a tendency of the system to approach equilibrium or to approach failure. The results showed that for a load of 0.8 g. at all temperatures the system indicated success in the digestibility of the organic matter. At a load of 3.2 g. at 70 F and 50 F the system tended toward failure. (Christenbury-Iowa State)

0370 - C3, E3

EFFECT OF SOIL TEMPERATURE ON THE AVAILABILITY OF PHOSPHORUS IN ANIMAL MANURES,
California Univ., Davis.
J. L. Abbott, and J. C. Lingle.
Soil Science, Vol 105, No 3, p 145-152, 1968. 3 tab, 5 fig, 14 ref.

Descriptors: *Farm wastes, *Phosphorus, Water pollution effects, Nutrients, Organic matter, Nitrogen, Carbon dioxide, Soil temperature, Plant growth.
Identifiers: *Animal manure, Available phosphorus, Plant response.

Steer, dairy, sheep, and poultry manures, and alfalfa supplemented with monocalcium phosphate added to two slightly acid soils at the rate of 50 ppm. total P and supplied plant-available P to two successive crops - turnips and tomatoes. Dry-weight yield and total P in the tissues provided data for evaluating plant-available P in the manures. In the Sierra sandy loam at the medium soil temperature, uptake of P by turnips was greater from the sheep, poultry, and alfalfa plus PO4 treatments than from the dairy manure treatment. In the Gridley clay loam at 15 deg C. soil temperature, uptake of P by turnips was greater from the poultry manure treatment than from the other treatments. Soil temperature had no measurable effect on the availability of manurial P to tomatoes. At all soil temperatures, P-solubilizing processes, including mineralization of the organic P in both soils and amendments, appeared to contribute to the P absorbed by plants. These processes appeared to continue during the second cropping period, notably at the low (20 deg C.) soil temperature, after having been previously cropped for 5 weeks and incubated for 3 weeks at 15 deg C. Manures yielded more available P in the Sierra than in the Gridley soil. From these data, the HOAc-soluble:nonsoluble P ratios of manures could not be said to have influenced the availability of manurial P to plants. On an equal dry-weight basis, the overall effectiveness of manures in supplying available P depended on their respective total P contents: poultrySsheepSsteer — dairy. (Christenbury-Iowa State)

0371 - B2, E2

THIN SPREADING OF SLURRIED MANURES,

California Univ., Davis. Dept. of Agricultural Engineering.
Samuel A. Hart.
Transactions of the American Society of Agricultural Engineers, Vol 7, 1964, p 22-28. 9 fig, 3 tab, 21 ref.

Descriptors: *Farm wastes, *Slurry, *Drying, Cattle, Hogs, Poultry, Moisture content, Viscosity, Pumps, Bulk density, Volume, Nitrogen, Odor, Organic matter, Carbon dioxide, Waste water treatment.
Identifiers: *Spreading, *Thin spreading, *Fluidization, Liquefaction, Solids per cent, Fly breeding, Slump, Layers, Layer thickness, Surface area.

The purpose was to determine how thick a layer of manure could be spread, day after day, layer upon layer, and still prevent fly breeding or other sanitation problems. Chicken and dairy manure was fluidized to 10 to 20 percent solids, and then spread in layers on two sets of six plots. The six plots in each series were dosed with increasing thicknesses of manure: from 1/25 to 1/4 inch for the chicken plots; 1/20 to 3/10 inch for the dairy plots. A specific plot received the same dose at each of the 47 applications. At a solids content of 85 percent, fly breeding was prevented. A significant amount of organic matter is lost during drying and storage, the loss being related to the moisture content of the plot. One-half of the nitrogen originally present in the manure is also lost. The land area needed for cumulative layering is not large - less than 200 sq. ft. per cow and 1 sq. ft. per chicken. Odors can and do occur in manure thin spreading, but can be minimized by layering of fresh manure only. (White-Iowa State)

0372 - A2, A4, C1, D1, E1

DRAINAGE AND POLLUTION FROM BEEF CATTLE FEEDLOTS,

Cornell Univ., Ithaca, N.Y. Dept. of Civil and Agricultural Engineering.
Raymond C. Loehr.
Journal of the Sanitary Engineering Division, ASCE, Vol 96, No SA6, p 1295-1309, 1970. 4 fig, 1 tab, 26 ref.

Descriptors: *Drainage, *Water pollution, *Cattle, Runoff, Groundwater, Nutrients, Biochemical oxygen demand, Rainfall, Chlorides, Nitrogen, Ammonia, Phosphates, Chemical oxygen demand, Acids, Water pollution sources, Water pollution effects, Bacteria, Retention, Waste disposal, Management, Water pollution control.
Identifiers: *Feedlots, Animal production, Cattle wastes, Volatile acids, Land application.

The specialization of the livestock production industry established the trend of confinement feeding and increasing animals per feeding operation. Uncontrolled waste discharges from these operations are a source of water pollution by excessive nutrients, microorganisms impairing recreation waters, impurities in groundwater, contaminants that complicate water treatment, and dissolved oxygen depletion causing fish kills. Runoff from concrete surfaced feedlots contains higher organic matter and nitrogen concentrations than runoff from unsurfaced. Groundwater contamination from nitrates is significant during and after the lot life. Absorption of ammonia volatilized from cattle feedlots can contribute to nitrogen enrichment of surface waters in their vicinity. In the midwest and southwest, retention ponds with controlled discharge and retention-evaporation ponds can provide satisfactory control and treatment. Approved facilities in Kansas include runoff diversion, retention ponds for all waste water and runoff containing animal wastes and application of both liquid and solid wastes to agricultural land. Enclosed housing beef cattle production will minimize contamination of runoff and avoid runoff pollution problems. (Jones-Wisconsin)

0373 - A8

ARTHROPOD PREDATORS OF IMMATURE DIPTERA DEVELOPING IN POULTRY DROPPINGS IN NORTHERN CALIFORNIA: PART I,

California Univ., Berkeley. Dept. of Entomology and Parasitology.
John H. Peck, and John R. Anderson.
Journal Medical Entomology, Vol 6, No 2, p 163-167, May 31, 1969. 4 tab, 19 ref.

Descriptors: *Poultry, *Diptera, Farm wastes, Biocontrol, Sampling, California, Seasonal, Moisture content, Animals, Mites.
Identifiers: *Arthropod predators, Fly control, Filth flies, Cohabitation, Poultry droppings, Predatory fauna, Coleoptera, Enumeration.

Arthropod predators occurring in manure at 2 Sonoma County, California, poultry ranches were identified and studied. Seasonal abundance and association with prey were determined for the following major predators: Macrocheles muscaedomesticae, Glyptholaspis confusa, Fuscuropoda sp., Carcinops pumilio, Margarinotus merdarius, Philonthus politus, P. sordidus, Staphylinus maxillosus villosus, Muscina stabulans, and Ophyra leucostoma. (White-Iowa State)

0374 - A8

ARTHROPOD PREDATORS OF IMMATURE DIPTERA DEVELOPING IN POULTRY DROPPINGS IN NORTHERN CALIFORNIA: PART II,

California Univ., Berkeley. Dept. of Entomology and Parasitology.
John H. Peck.
Journal Medical Entomology, Vol 6, No 2, p 168-171, May 31, 1969. 4 tab, 15 ref.

Descriptors: *Poultry, *Diptera, California, Seasonal, Predation, Mites, Mortality, Insect eggs, Larvae, Light, Farm wastes.
Identifiers: *Arthropod predators, Predation potential, Media cohabitation, Pupae, House fly eggs, Variance, Poultry droppings.

The feeding responses of 3 species of predaceous Staphylinidae and 2 species of predaceous Histeridae were studied by exposing them to eggs, larvae and pupae of Musca domestica and Fannia femoralis. Studies of age-of-prey specific predation by M. muscaedomesticae on immature M. domestica showed that most mortality was inflicted on eggs and first instar larvae. Predation rates were determined for the above and 6 other predaceous species; the following indices of predation potential were computed for the 5 most abundant predators: Fuscuropoda sp. (adults) - 3.5, Glyptholaspis confusa females - 4.4, Macrocheles muscaedomesticae females - 95.8, Carcinops pumilio (adults) - 97.0, and Ophyra leucostoma L3 - S226.4. The potential importance of the above predators is discussed with reference to their seasonal and media cohabitation with various prey species. (White-Iowa State)

0375 - A2

RURAL RUNOFF AS A FACTOR IN STREAM POLLUTION,

Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio Cincinnati Water Research Lab.
R. B. Weidner, A. G. Christianson, S. R. Weibel, and G. G. Robeck.
Journal Water Pollution Control Federation, Vol 41, No 3, p 377-384, March 1969. 10 tab, 6 fig, 3 ref.

Descriptors: *Surface runoff, *Water pollution, Farm wastes, Storm runoff, Water quality, Acreage, Cultivated lands, Grasslands, Pastures, Forests, Urbanization, Land use, Nitrogen, Phosphorus, Soil erosion, Watersheds, Physical characteristics, Slopes, Fertilizers, Pesticides, Mulching, Flow measurement, Sampling, Flumes, Coliforms, Precipitation, Rainfall intensity, Time, Corn, Regression analysis, Biochemical oxygen demand, Chemical oxygen demand.
Identifiers: Soil characteristics, Measuring flume.

The results of this work indicate that rural runoff is a factor in stream pollution and that it must be considered when one evaluates the quality of any stream or receiving body of water. However, there also must be an awareness that there are some means available for reducing this pollutional load. This study showed that, despite an increase in the amount of fertilizers and manure applied under improved practices, there was a marked decrease in the amount of pollutional load that came from these watersheds as contrasted to the load from watersheds using prevailing practices. Runoff, soil loss, and microbial densities were considered. (White-Iowa State)

0376 - C4

EVALUATION OF SEVERAL METHODS OF ISOLATING SALMONELLA FROM POULTRY LITTER AND ANIMAL FEEDSTUFFS,

Massachusetts Univ. Amherst. Dept. of Veterinary and Animal Sciences.
C. F. Smyser, and G. H. Snoeyenbos.
Avian Diseases, Vol 13, No 1, p 134-141, 1969. 5 tab, 13 ref.

Descriptors: *Salmonella, *Poultry, Bacteria, Farm wastes, Microorganisms, By-products, Incubation, Sampling, Frequency.
Identifiers: *Poultry litter, *Feedstuffs, Enrichment broths, Selenite broth, Animal by-products, Feed mills, Rendering plants, Tetrathionate broth, Significant difference, Proteus.

A comparison of several different culture procedures for Salmonella isolations, using selenite-brilliant green-sulfapyridine (SBG sulfa) and tetrathionate brilliant green (TBG) as enrichments was made with 198 litter samples of which 161 were positive by one or more methods, and with 371 animal feedstuff samples of which 111 were positive by one or more methods. All enrichments were streak-plated after 48 hour incubation. SBG sulfa incubated at 43C was superior to SBG sulfa at 37C, and to TBG at 37C with or without pre-enrichment for the isolation of salmonellae from poultry litter and animal feedstuffs. Significantly more samples of animal feedstuffs yielded salmonellae from SBT sulfa at 43C than from the other two media. More salmonella colonies and fewer competing organisms were usually obtained on BG agar plated from SBG sulfa at 43C than from either SBG sulfa at 37C or TBG. SBG sulfa appeared to be a more favorable enrichment medium than TBG for isolating S. senftenberg; differences in the number of isolations among several other serotypes were too small for comparison. (White-Iowa State)

0377 - E2

EFFECTS OF ORGANIC MANURES ON SOILS AND CROPS,

Reading Univ. (England). Dept. of Agricultural Botany.
A. H. Bunting.

Proceedings Nutrition Society, Vol 24, No 1, p 29-34, 1965. 4 tab, 14 ref.

Descriptors: *Soils, *Crops, *Organic matter, Fertilizers, Farm wastes, Nitrogen, Phosphorus, Potassium, Crop production, Nutrients, Wheat, Potatoes, Sewage sludge, Calcium, Fertility, Temperature, Moisture content, Soil structure.
Identifiers: *Farmyard manure, *Organic manures, Mineral fertilizers, Sludge compost, Minor elements.

The paper reports on the effects organic manure, and especially farmyard manure, has on different soils and crops. The effects of organic manures on crops are often important, but they are largely associated with changes in the supply of nutrients. However, there is good evidence that on some special soils, they have special effects on crop growth. The paper then focuses on changes which take place in the soil as a result of organic matter addition. Moisture content and soil structure are most particularly affected. (White-Iowa State)

0378 - D4
TREATMENT OF LIVESTOCK WASTE -- A LABORATORY STUDY,
Missouri Univ., Columbia. Dept. of Sanitary Engineering; and Missouri Univ., Columbia. Dept. of Agricultural Engineering.
E. A. Jeffrey, W. C. Blackman, and Ralph Ricketts.
Transactions of the American Society of Agricultural Engineers, Vol 8, No 1, 1965, p 113-117, 126. 6 fig, 5 tab, 17 ref.

Descriptors: *Farm wastes, *Lagoons, *Anaerobic digestion, *Hogs, Aerobic treatment, Lagoons, Cattle, Sheep, Aeration, Sludge, Domestic wastes, Hydrogen ion concentration, Digestion tanks, Biochemical oxygen demand, Chemical oxygen demand, Waste dilution, Nitrification, Manometers, Design standards, Design criteria, Waste water treatment.
Identifiers: *Aerobic lagoon, Agitation, Volatile solids, Total solids, Beuch scale aerators, BOD/COD ratio, Detention time.

A study was made of the aerobic and anaerobic digestion characteristics of livestock wastes. The results obtained in the hog waste digestion studies are compared to design criteria for domestic sludge digestion units. Design loading conditions and water requirements are calculated for using an anaerobic lagoon for treating hog wastes. Design requirements for an aerobic lagoon are also indicated. It is concluded that disposal of hog wastes by use of aerobic lagoons is prohibitive because of the large requirements of both water and land area. The use of anaerobic lagoons is feasible, but it is accompanied by the problem of eventually having to dispose of the accumulated digested sludge. Future studies should be made on the operation of series lagoons. By using the first lagoon for settling and as an anaerobic lagoon, the area requirement of the second to serve as an aerobic lagoon would be greatly reduced, perhaps to the point of practicality. (White-Iowa State)

0379 - D3, E3
A REPORT ON THREE MANURE COMPOSTING PLANTS,
Public Health Service, San Francisco, Calif.
John S. Wiley.

Compost Science, Vol 5, Summer 1964, p 15-16. 3 fig.

Descriptors: *Farm wastes, Public health, Cattle, Poultry, Organic wastes, Aerobic conditions, Anaerobic conditions, Mositure content, Aeration, Odor, Pathogenic bacteria, Screens, Nitrogen, Ammonia.
Identifiers: *Composting, *Aerobic decomposition, Nuisance, Fly production, Windrow composting, Rotary drum composter, Soil conditioner.

The article describes three manure composting plants which process manure in a sanitary, economical manner and use the product as a soil conditioner. One plant treats a mixture of feedlot manure from 5500 steers and meat packing wastes in long windrows which are turned six times during the six week composting period. The other two plants treat poultry manure in rotary drum composters. Each of these two plants treats wastes from one million birds. The compost is sold as a humus plant food. The three plants are interesting attempts to process manures in a sanitary manner and to utilize the resulting product for the benefit of the soil. (White-Iowa State)

0380 - E2
TWO BILLION TONS OF - WHAT,
Department of Agriculture, Beltsville, Md. Livestock Engineering and Farm Structures Research Branch.
Harry J. Eby.
Compost Science, Vol 7, p 7-10, Autumn 1966. 2 fig.

Descriptors: *Farm wastes, *Volume, *Organic wastes, Domestic wastes, Cattle, Poultry, Nutrients, Value, Organic matter, Topsoil, Turf, Water pollution, Percolation, Fertilizers, Filters.
Identifiers: *Waste production, *Grass belts, *Composting, Population equivalent, Land disposal, Pollution control.

The author advocates managing our millions of tons of organic waste, both farm and municipal, in such a way that grass belts would be planted along the borders of streams and rivers. The organic wastes would be worked into these areas in large quantities to improve the quality of the soil. His proposal is based on three factors: (1) Soil with a high organic content holds more water than soils with little organic content. (2) Incorporating organic matter into a clay soil improves its percolation rate as well as its water-holding capacity. (3) Soil is a good bacterial filter. Thus the grass belts would act as a means of stream and river pollution control. The author feels that more research is needed to find components of manure which would have continuing industrial or commercial applications. Examples are given illustrating the magnitude of the animal waste disposal problem. (White-Iowa State)

0381 - D4
WASTES FROM PIG PRODUCTION UNITS,
Tay River Purification Board (Scotland); and North of Scotland Coll. of Agriculture, Aberdeen. Scottish Farm Buildings Investigation Unit.
R. A. Pontin, and S. H. Baxter.
Water Pollution Control, Vol 67, No 6, 1968, p 632-638. 4 tab, 4 fig, 11 ref.

Descriptors: *Farm wastes, *Hogs, *Activated sludge, Foaming, Freezing, Rotors, Effluent, Biochemical oxygen demand, Odor, Construction, Rubber, Linings, Recirculated water, Operations, Slurries, Sludge, Dissolved oxygen, Costs, Aeration, Water pollution, Public health, Lagoons, Anaerobic digestion, Filtration, Waste water treatment.
Identifiers: *Oxidation ditch, Slatted floor, Primary ditch, Secondary ditch, Suspended solids, Layout, Rubber sheeting, Continuous operation, Intermittent operation, Land disposal, Composting, Extended aeration.

Methods for the disposal or treatment of the increasing quantities of slurry from intensive pig production units are outlined. The possible application of the oxidation ditch for such treatment is discussed and the results of experiments of a commercial piggery are described. The authors conclude that the method offers the promise of an economic solution but that further research is urgently needed. (White-Iowa State)

0382 - C4
TYPE DISTRIBUTION OF COLIFORM BACTERIA IN THE FECES OF WARM-BLOODED ANIMALS,
Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio.
E. E. Geldreich, R. H. Bordner, C. B. Huff, H. F. Clark, and P. W. Kabler.
Journal Water Pollution Control Federation, Vol 34, No 3, March 1962, p 295-301. 4 tab, 24 ref.

Descriptors: *Coliforms, *Bacteria, *E. coli, *Farm wastes, Domestic wastes, *Temperature, Cattle, Hog, Sheep, Poultry, Membrane filters, Variability, Water pollution, Surface drainage.
Identifiers: Detection, Enumeration, IMViC, BALB, EC broth procedure, MPN test, Biochemical tests, Correlation.

This investigation examined the reactions of 4512 human, 2339 livestock, and 1896 poultry coliform strains isolated from 43 human, 32 livestock, and 28 poultry fecal samples. The EC procedure showed a 96.3 percent positive correlation and the BALB procedure a 95.3 percent correlation with the coliforms from fecal sources. These findings suggest that the presence of EC or BALB positive coliform strains in water or wastes indicate relatively recent fecal pollution. An occasional shift in percent positive correlation of the elevated temperature test for three human samples during a period of one to three years was noted. The biochemical tests comprising the IMViC typing classification are cumbersome and do not present as close a correlation with fecal origins of the coliform group as other procedures. In view of the excellant reliability of either the EC or BALB test for fecal coliform bacteria, and taking into account the saving in time and effort, the elevated temperature procedure seems to be the method of choice. (White-Iowa State)

0383 - F2
PORK PRODUCERS AND POLLUTION: LEGAL ASPECTS,
Missouri Univ., Columbia. Dept. of Agricultural Economics.
Donald P. Levi.
Paper delivered at the Annual Meeting of Missouri Pork Producers Association, January 16, 1970, Columbia, Missouri. Agricultural Economics Paper No. 1970-6. 15 p.

Descriptors: *Legal aspects, *Regulation, Farm wastes, Disposal, Missouri, Maintenance, Waste water treatment, Water pollution control.
Identifiers: *Pollution laws, *Lawsuits, Nuisance law, Liability, Stockmen, Law.

Pollution of water and air by feeding operations is becoming a very real problem. Whether this constitutes a nuisance is a question of fact and depends on the circumstances of each case. The relative interests of the parties involved will determine whether or not a given operation is closed down. Even if one is legally allowed to continue in business, the assessment of actual or punitive damages may make it unprofitable to do so. There is no one thing which farmers can do to guarantee that they be free from nuisance actions. Site selection, proper maintenance, zoning and licensing may help in some cases. (Christenbury-Iowa State)

0384 - A1, B1, F4
THE ECONOMICS OF CLEAN WATER: ANIMAL WASTES PROFILE.
Federal Water Pollution Control Administration, Washington, D.C.

For sale by Supt. of Documents, U. S. Govt. Printing Office, Washington, D. C. 20402. Price $1.00. March 1970. Vol 2, 85 p, 18 fig, 10 tab.

Descriptors: *Animal populations, *Farm wastes,

*Water pollution sources, *Water pollution control, *Cost analysis, Cattle, Sheep, Poultry, Hogs, Livestock.
Identifiers: *Animal wastes, *Clean water, *Feedlots, Swine, Milk cows, Stream pollution.

A comprehensive view is provided of the problem of farm-animal wastes in the United States in relationship to pollution of water bodies. A framework is established for estimating costs of animal wastes control to prevent water pollution. In many cases animal wastes have proved to be significant pollution sources that resulted in fish kills and extensive damage to the ecology of the streams. At the present time, however, there is general agreement that not all of the wastes need to be considered as sources of water pollution. Therefore, it would seem that entirely too much emphasis has been placed on the gross possible costs of controlling water pollution from animal wastes. A more realistic base for use in developing programs for water pollution abatement and control from animal wastes is a series of sub-elements that can be independently assessed to determine their pollution potential, applicable control measures, and total pollution control costs. Estimates are presented of the locations, by states, of populations of cattle, milk cows, swine, sheep, and poultry together with discussions of water pollution control practices, wastes discharge frequencies from feedlots, and climate effects.

0385 - A6, C5

AIR POLLUTANTS AFFECTING THE PERFORMANCE OF DOMESTIC ANIMALS - A LITERATURE REVIEW.
Agriculture Research Service, Washington, D.C.

For sale by the Superintendent of Documents, US Government Printing Office, Washington, DC 20402 - Price $1.00. Agriculture Handbook No 380, Issued August 1970. 109 p, 666 ref.

Descriptors: *Domestic animals, *Air pollution effects, *Toxicity, Pollutant identification, Air pollution, Atmsophere, Smoke, Pollutants, Physiological Ecology, Legislation, Farm wastes, Laboratory studies, *Reviews, *Bibliographies, Water pollution effects.
Identifiers: Inhalation, Ingestion, Veterinary diagonosis, Esthetic effects, Automobile exhausts.

The results of a Literature Survey to determine the effects of air pollution on domestic animals is presented. The term 'domestic animals' as used in this report includes cattle, sheep, goats, swine, horses, chickens, turkeys, ducks, geese, pigeons, Japanese quail, dogs, cats, rabbits, and honey bees. Chapters 2, 3, and 4 on air pollution, smoke, and automobile exhausts provide a brief background on the generalities of these pollutants and their effects on domestic animals. Many of the specific air pollutants found in the air, smoke, and automobile exhausts are described in subsequent chapters, which contain a brief introduction of the air pollutant, the published results, a summary, and a bibliography. (Christenbury-Iowa State)

0386 - F4

INTRODUCTION: ISSUES IN FOOD PRODUCTION AND CLEAN WATER,
Agricultural Research Service, Beltsville, Md. Water Conservation Research Div.
Cecil H. Wadleigh, and Clarence S. Britt.
Agricultural Practices and Water Quality, Iowa State University Press, Ames, Iowa, 1970, Introduction, p xix-xxvii. 1 tab, 3 fig, 4 ref.

Descriptors: *Farm wastes, *Environment, Cattle, Poultry, Hogs, Ammonia, Fertilizers, Nitrogen, Corn, Labor, Nutrients, Potassium, Biochemical oxygen demand, Runoff, Fishkill, Effluent, Pesticides, Coliforms, Nitrates, Eutrophication, Phosphorus, Oxygen, Fish, Conservation, Lagoons, Odor, Sprinkler irrigation, Water quality.
Identifiers: *Waste production, *Feedlots, Mechanization, Chicken litter.

The article introduces the subject matter and content of the book. A look is first taken at the increased consumption of meat in this country. From the total number of animals raised for slaughter, an idea is given of the amount and scope of the animal waste disposal problem. To raise this large number of animals the agricultural industry has relied on a variety of chemical fertilizers and pesticides to increase yields. Runoff from feedlots and agricultural lands has caused eutrophication and associated fish kills. However these are not the only nutrient sources. Conservation practices are needed to prevent water flowing through feedlots to run directly into a water course. As such secondary or even tertiary lagoons may be required. Recycling of wastes should be the optimum means of disposal. Sound conservation farming is needed to assure beneficial use of agricultural wastes and to effectively protect the quality of water in our streams and reservoirs. (White-Iowa State)

0387 - A2, A3, C2

POLLUTION BY SEDIMENT: SOURCES AND THE DETACHMENT AND TRANSPORT PROCESSES,
Iowa State Univ., Ames. Dept. of Agricultural Engineering; and Agricultural Research Service, Beltsville, Md. Water Conservation Research Div.
H. P. Johnson, and W. C. Moldenhauer.
Agricultural Practices and Water Quality, Iowa State University Press, Ames, Iowa, 1970, Chapter 1, p 3-20. 2 tab, 2 fig, 59 ref.

Descriptors: *Water pollution, *Sediments, *Sediment transport, Bed load, Suspended load, Soil erosion, Gully erosion, Sheet erosion, Rill erosion, Sediment yield, Watersheds, Iowa, Losses, Regression analysis, Specific weight, Streams, Yield equations.
Identifiers: *Detachment, *Erosion equation, Universal Soil Loss Equation, Correlation coefficient, Sediment delivery ratio, Reservoir sedimentation.

The paper attempts to identify problems in the sediment pollution area, define the present understanding of the erosion and transport process, and to indicate research needs. Gross erosion from land, including both sheet and gully erosion, is discussed, and empirical methods of quantitative measurement are presented as well as research approaches. Primary sources of sediment yield information are reservoir sedimentation surveys and suspended load samplings. Finally a look is taken at sediment in transport and its two components suspended load and bed load. The science of erosion and sediment transport needs to advance considerably if it is to be sufficiently flexible for use in detailed planning. (White- Iowa State)

0388 - C2

CHEMISTRY OF SEDIMENT IN WATER,
Agricultural Research Service, Morris, Minn. Soil and Water Conservation Research Div, and Minnesota Agricultural Experiment Station, St. Paul.
R. F. Holt, R. H. Dowdy, and D. R. Timmons.
Agricultural Practices and Water Quality, Iowa State University Press, Ames, Iowa, 1970, Chapter 2, p 21-34. 2 fig, 1 tab, 49 ref.

Descriptors: *Sediments, *Nitrogen, *Phosphorus, Chemistry, Water pollution, Clays, Mineralogy, Montmorillonite, Illite, Colloids, Clay minerals, Organic matter, Ions, Ion exchange, Cation exchange, Anion adsorption, Oxidation-reduction potential, Nitrification, Denitrification.
Identifiers: Preferential removal, Electrical charge, Surface area, Reduced layer, Surface oxidized layer.

Sediment can be considered a major pollutant of surface waters. However, its contribution to the dissolved chemicals in lakes and streams is largely unknown. The composition of sediment closely resembles the soil from which it is derived but is generally higher in silt, clay, and organic matter. Chemical reactions involving sediment are essentially the surface chemistry of their colloidal fractions which is a function of their surface area and electrical charge. As a result, reactions with sediment can be divided into interactions with charged ions and with neutral compounds. The chemistry of sediments in situ can be surmised from studies of submerged soils. Sediments carry relatively large amounts of total nitrogen and phosphorus into surface waters, but in both cases only a small proportion of this total is readily available to the biosystem. Sediments apparently have a high capacity to remove phosphate from solution, but without turbulence the release of phosphate from bottom sediments will not support algal growth at appreciable distances from the sediment. Available inorganic nutrients, particularly phosphorus, are rapidly taken up by the biosystem in natural waters. They eventually become a part of the organic fraction of the sediment and their release back to the waters is not well resolved. (White-Iowa State)

0389 - B1

LAND AND WATER MANAGEMENT FOR MINIMIZING SEDIMENT,
Iowa State Univ. Ames. Dept. of Agronomy.
Minoru Amemiya.
Agricultural Practices and Water Quality, Iowa State University Press, Ames, Iowa, 1970, Chapter 3, p 35-45. 5 tab, 28 ref.

Descriptors: *Land management, *Water management, *Sediments, *Soil erosion, Sediment yield, Soil stabilization, Sediment transport, Energy dissipation, Soil properties, Slopes, Farm management, Infiltration, Storage capacity, Vegetation, Velocity, Flow, Mulching, Erosion control, Cultivation, Runoff, Strip cropping, Terracing, Contour farming.
Identifiers: Detachment, Universal Soil Loss Equation.

The most logical and direct approach to solving our agriculturally related sediment problem is the stabilization of the sediment source by controlling soil erosion through the use of proper land and water management practices. An understanding of the factors affecting soil erosion by water is required in order to effectively protect the soil. The Universal Soil Loss Equation provides a framework for discussing erosion control measures. A vegetative cover or surface mulch is one of the most effective means of controlling runoff and erosion, and is discussed in some detail. A natural result of this fact is the creation of tillage methods which leave a mulch or crop residue on the surface. Examples of their effectiveness in controlling soil erosion are given. Contour farming, strip-cropping and terracing are slope modification methods for erosion control. Slope modification measures combined with soil conserving tillage practices can be effective in reducing soil erosion from cropped land. However, to become widely accepted, such practices must fit efficient farming operations and must be economically feasible. (White-Iowa State)

0390 - A3, E2

SIGNIFICANCE OF PHOSPHORUS IN WATER SUPPLIES,
Southern Illinois Univ., Carbondale. Dept. of Botany.
Jacob Verduin.
Agricultural Practices and Water Quality, Iowa State University Press, Ames, Iowa, 1970, Chapter 5, p 63-71. 1 fig, 4 tab, 12 ref.

Descriptors: *Phosphorus, *Nutrients, Water pollution, Fertilizers, Oxygen, Nitrogen, Sewage, Effluents, Phosphates, Carbon dioxide, Odor, Taste,

Eutrophication, Water sheds, Tennessee Valley Authority Project, Detergents, Farm wastes, Lagoons.
Identifiers: *Plant nutrients, N/P ratio, Enrichment.

The author gives data showing the marked increase in total phosphorus concentrations in our streams and lakes. Although there has been a large increase in agricultural fertilizer use, evidence suggests that approximately one-third of the phosphorus contributions may come from agricultural watersheds. In urban sewage effluents, detergents seem to contribute about three times more phosphate than is contributed by the organic matter in sewage. Consequently, detergents would appear to be the most significant single source of phosphates enriching our waters today. The author contends that animal and domestic wastes belong on the land as fertilizer and soil improvers rather than discharging nutrient rich lagoon and sewage plant effluents directly to streams. As such, agriculture has a primary role to play in the solution of the pollution problem. In the problem of removing concentrated nutrients from water, agricultural technology can make a major contribution in the application of the living root zone filter to the process of plant nutrient removal. (White-Iowa State)

0391 - A3, E2

BEHAVIOR OF SOIL AND FERTILIZER PHOSPHORUS IN RELATION TO WATER POLLUTION,

Iowa State Univ., Ames. Dept. of Agronomy.
C. A. Black.
Agricultural Practices and Water Quality, Iowa State University Press, Ames, Iowa, 1970, Chapter 6, p 72-93. 10 fig, 1 tab, 57 ref.

Descriptors: *Phosphorus, *Soils, Water pollution, Phosphates, Fertilizers, Solubility, Organophosphorus compounds, Groundwater, Surface waters, Aqueous solutions, Saturation, Distribution, Adsorption.
Identifiers: *Orthophosphate, Plant residues, Concentrations, Biological cycle, Phosphorite, Langmuir equation, Reaction capacity.

The principal objective of this chapter is to present an account of selected aspects of the behavior of soil and fertilizer phosphorus as a basis for understanding how phosphorus from these sources may contribute to the phosphorus content of waters in the soil and leaving the soil. Chemical and geologic phosphorus cycles in the soil are traced. The reactions and distribution of fertilizer phosphorus in soil are described. The distribution of both inorganic and organic phosphorus is pointed out. (White-Iowa State)

0392 - A3, A4, C3, E2

SOURCES OF NITROGEN IN WATER SUPPLIES,

Geological Survey, Denver, Colo.
Marvin C. Goldberg.
Agricultural Practices and Water Quality, Iowa State University Press, Ames, Iowa, 1970, Chapter 7, p 94-124. 4 fig, 8 tab, 72 ref.

Descriptors: *Nitrogen, *Nitrates, Groundwater, Ammonia, Precipitation, Sediments, Denitrification, Runoff, Ureas, Fertilizers, Drainage water, Irrigation, Return flow, Water supply, Livestock, Sewage, Infiltration, Industrial wastes, Algae, Ponds, Farm wastes.
Identifiers: *Surface waters, Geological sources, Mineralization, Nitrogen sources, Well water, Feedlots.

Water supplies can be categorized as surface waters or groundwaters. This paper examines representative studies of nitrate entrance to both types of water supplies, with summaries of some of the many laboratory and field studies described in the current literature. Some of the sources of nitrogen entrance to water supplies include atmospheric, geologic, rural and urban runoff, sewage, irrigation, animal wastes, and industrial wastes among many others. Sources of major importance to both surface and groundwater supplies are pointed out and field or laboratory studies are reported. (White-Iowa State)

0393 - C3, E2

CHEMISTRY OF NITROGEN IN SOILS,

Illinois Univ., Urbana. Dept. of Agronomy; and Missouri Univ., Columbia. Dept. of Agronomy.
F. J. Stevenson, and G. H. Wagner.
Agricultural Practices and Water Quality, Iowa State University Press, Ames, Iowa, 1970, Chapter 8, p 125-141. 8 fig, 26 ref.

Descriptors: *Nitrogen, *Nitrates, *Ammonium compounds, Fertilizers, Inorganic compounds, Nitrites, Microorganisms, Climates, Nitrification, Denitrification, Leaching, Organic matter, Amino acids, Lignins, Chemistry, Soils.
Identifiers: *Fixation, Mineralization, Immobilization, Volatilization, Amines, Pyrimidine.

This review emphasizes the complex nature of soil nitrogen. Other than gaseous forms, the inorganic N consists primarily as NH4 (..) and NO3 (-). Part of the NH4 (..) is bound to colloidal surfaces and behaves according to classical reactions of exchange chemistry. Nitrate is free to move with the soil water and is the form of N which is of greatest concern from the standpoint of pollution of water supplies. Many soils contain appreciable amounts of NH4 (..) that cannot be utilized directly by plants and microorganisms; this NH4 (..) is held within the lattice structures of clay minerals. Less than one-half of the organic N in soils can be accounted for in known compounds (amino acids, amino sugars, purine and pyrimidine bases, etc.). The remainder may occur as part of the structures of humic and fulvic acids. Part of the N added to soils as fertilizers can be converted to organic forms by chemical reactions involving NH3 (..) and NO2 (-); this combined N is only slowly mineralized and may persist in soil for prolonged periods. Bacterial denitrification is an important factor regulating NO3 (-) levels in natural soil and may serve as a means of reducing the NO3 (-) content of groundwater when land is used for the disposal of nitrogenous wastes. (White-Iowa State)

0394 - A3, E1

FERTILIZER MANAGEMENT FOR POLLUTION CONTROL,

Minnesota Univ., St. Paul. Dept. of Soil Science.
W. P. Martin, W. E. Fenster, and L. D. Hanson.
Miscellaneous Publication Paper No 1360 of the University of Minnesota Agricultural Experiment Station, St. Paul. Agricultural Practices and Water Quality, Iowa State University Press, Ames, Iowa, 1970, Chapter 9, p 142-158. 68 ref.

Descriptors: *Fertilizers, *Nitrogen, *Phosphorus, Nutrients, Phosphates, Soil erosion, Sedimentation, Sediments, Soils, Water supply, Eutrophication, Cultivation, Nitrates, Farm wastes, Wells, Water pollution, Nitrification, Irrigation, Denitrification.
Identifiers: *Pollution control, *Fertilizer use, Nutrient removal, Feedlots.

Nitrogen and phosphorus, as nutrient elements, are important to both land and aquatic plants, and normally reach water supplies via land runoff in the erosion debris. Fertilizer usages in the midcontinent area are rapidly increasing to maximize production and increase efficiency, and further increases are expected. Fertilizer phosphorus quickly converts to unavailable forms in mineral soils and the evidence indicates that one of the ways of reducing the level of soluble phosphorus in water would be to effect soil contact such as by filtration through the soil medium. Nitrogen fertilizer application rates should approximate crop needs, which for a given soil type and climatic zone are based on production potential estimates for the crops to be grown. Management recommendations refined through the years for maximizing production are not incompatible with the objective of reducing nutrient contamination of natural waters. Further research is needed on nutrient balances and reactions in soils to maintain supplies at levels needed for crop production. Water quality standards as established by the federal and state water pollution control groups should be compatible with the need for maintaining adequate nutrients for efficient crop production consistent with management programs designed to minimize losses to adjacent water supplies. (White-Iowa State)

0395 - A7

CHEMISTRY AND METABOLISM OF INSECTICIDES,

Iowa State Univ., Ames. Dept. of Zoology and Entomology.
Paul A. Dahm.
Journal Paper No. J-6509 of the Iowa Agriculture and Home Economics Experiment Station, Ames, Iowa. Agricultural Practices and Water Quality, Iowa State University Press, Ames, Iowa, 1970, Chapter II, p 167-182. 6 fig, 1 tab, 62 ref.

Descriptors: *Insecticides, *DDT, *Aldrin, Dieldrin, Insects, Carbamate pesticides, Insect control, Metabolism, Organophosphorus pesticides, Chlorinated hydrocarbon pesticides, Pesticide toxicity, Pesticide residues.
Identifiers: Toxaphene, Parathion, Malathion, Carbaryl, Metabolites, Arthropods.

Insecticides occur in the environment because of purposive applications for pest control and because of accidents and carelessness. The major problems with insecticides arise from the contamination of the environment and food and the development of resistant arthropod-pest populations. The persistence of insecticides in the atmosphere, water, soil, plants, animals, and microorganisms is being investigated. Alterations of insecticides occur under both metabolic and nonmetabolic conditions. Knowledge of the metabolism of insecticides is prerequisite to their development and use for insect control. Identification and toxicological assessment of the metabolic products should precede establishment of residue and other safety factors. More basically, metabolism studies of insecticides reveal intoxication and detoxication processes and how these relate to physiological effects and problems of resistance. With some insecticides, primary metabolic attack may form compounds whose toxicity approximately equals or is greater than the parent insecticide. Numerous nonmetabolic factors exert effects on the structure and persistence of insecticides. The solubilities of insecticides in soil and water are especially important in relation to their movement and persistence in the environment. (White-Iowa State)

0396 - A7

THE PESTICIDE BURDEN IN WATER AND ITS SIGNIFICANCE,

Federal Water Pollution Control Administration, Athens, Ga. Southeast Water Lab.
H. Page Nicholson.
Agricultural Practices and Water Quality, Iowa State University Press, Ames, Iowa, 1970, Chapter 12, p 183-193. 3 tab, 32 ref.

Descriptors: *Pesticides, *DDT, Toxicity, Dieldrin, Chlorinated hydrocarbon pesticides, Aldrin, Endrin, Heptachlor, Runoff, Water pollution, Industrial wastes, Insecticides.
Identifiers: *Environmental contamination, Concentrations, Sources, Parathion, Pesticide pollution.

Sources of pesticide polluted water include runoff, industrial wastes, accidents and carelessness.

Graphic examples of each are given to gain perspective about the potential for pesticide involvement in water pollution. The significance of chlorinated hydrocarbon pesticides with respect to water pollution is shown. Concentrations in some lakes and streams has increased. A final section on control of pesticide pollution gives ideas and methods which should result in less water pollution by pesticides. (White-Iowa State)

0397 - A7, F5

HERBICIDE RESIDUES IN AGRICULTURAL WATER FROM CONTROL OF AQUATIC AND BANK WEEDS,

Agricultural Research Service, Denver, Colo. Crop Research Div; and Agricultural Research Service, Laramie, Wyo. Crops Research Div.
F. L. Timmons, P. A. Frank, and R. J. Demint.
Agricultural Practices and Water Quality, Iowa State University Press, Ames, Iowa, 1970, Chapter 13, p 194-208. 4 tab, 31 ref.

Descriptors: *Herbicides, *2-4-D, *Aquatic weed control, Dalapon, 2-4-5-T, Alligator weed, Copper sulfate, Ponds, Pond weeds, Reservoirs, Irrigation canals, Sprinkler irrigation, Furrow irrigation, Drainage, Water hyacinth, Runoff.
Identifiers: *Herbicide dissipation, Drainage ditches, Submersed weeds, Amitrole, Silvex.

The effectiveness of herbicides and the economics involved in agricultural production have caused their extensive use for weed control in and adjacent to aquatic areas, especially on irrigation systems. Greater use of herbicides in and around agricultural waters may be expected. Maximum residues of herbicides used for weed control in farm ponds and reservoirs are low, ranging from a fraction of 1 ppm to several ppm. In most cases these levels are of short duration. The transport of herbicide residues in irrigation water prevents extensive exposure of any given irrigated area. The flowing water may at times carry residues to areas where their presence may be objectionable. While reduction in residue level varies with canal and herbicide, many residues are dissipated after a water flow of 10 to 15 miles. In most cases, the dissipation can be attributed to dilution in water or absorption by bottom mud. The concentrations of herbicides found in irrigation water are unlikely to cause injury in crops. Where residues were found in crops following irrigation with water containing herbicides, the levels were generally much lower than tolerances already established for the same or similar crops. (White-Iowa State)

0398 - A3, A7

PESTICIDES AND PEST MANAGEMENT FOR MAXIMUM PRODUCTION AND MINIMUM POLLUTION,

Iowa State Univ., Ames. Dept. of Zqology and Entomology.
Don C. Peters.
Agricultural Practices and Water Quality, Iowa State University Press, Ames, Iowa, 1970, Chapter 14, p 209-223. 2 fig, 1 tab, 45 ref.

Descriptors: *Pesticides, *Pest control, Productivity, Water pollution, Climates, Insects, Control, Biocontrol, Cultural control, Chemcontrol, Mechanical control, Insecticides, Cotton, Timber management, Corn, Soybeans, Tobacco, Chlorinated hydrocarbon pesticides, 2-4-D, DDT.
Identifiers: *Pest management, Natural controls, Applied controls.

The author first discusses natural and applied controls which man utilizes in an effort to reduce losses caused by pests. Natural control can be subdivided into climatic, edaphic, and biotic aspects. Applied controls are biological, cultural, legal, or chemical practices. Examples of pest management in several areas of production are given. The role of agricultural pesticide use and clean water is pointed out. Suggestions are given, both legislative and practical, which can be used to reduce pesticide pollution of water. If the public demand for sophistication in pest control is to be achieved, more imaginative research support will have to be found.
(White-Iowa State)

0399 - A2, A3

LIVESTOCK OPERATIONS AND FIELD-SPREAD MANURE AS SOURCES OF POLLUTANTS,

Iowa State Univ., Ames. Dept. of Agricultural Engineering.
J. R. Miner, and T. L. Willrich.
In: Agricultural Practices and Water Quality, 1970, Iowa State University Press, p 231-240. 2 tab, 25 ref.

Descriptors: *Pollutants, *Confinement pens, Farm wastes, Biochemical oxygen demand, Chemical oxygen demand, Runoff, Liquid wastes, Groundwater, Lagoons. Water pollution sources, Water pollution, Waste water treatment.
Identifiers: *Pollution characteristics, Lagoon effluent, Feedlot runoff.

This paper deals with the pollution potential from animal wastes. The pollution characteristics of animal wastes and the surface water and groundwater pollution potentials are discussed. Runoff is a primary mode of transportation of the waste to the water supplies. This pollution can be minimized through proper management.
(Christenbury-Iowa State)

0400 - C1, E2

MANURE DECOMPOSITION AND FATE OF BREAKDOWN PRODUCTS IN SOIL,

Department of Agriculture, Lincoln, Neb.; and Iowa State Univ., Ames.
T. M. McCalla, L. R. Frederick, and G. L. Palmer.
In: Agricultural Practices and Water Quality, 1970, Iowa State University Press, p 241-255. 2 fig, 11 tab, 38 ref.

Descriptors: Farm wastes, Disposal, Fertilizers, Aerobic conditions, Anaerobic conditions, Microorganisms, Storage, Water pollution sources, Waste water treatment.
Identifiers: Fertilizer value, Composition, Breakdown, Decomposition.

This paper discusses the composition of animal manure. Fresh manure contains from 30 to 80% water. The rest of the constituents in manure are inorganic and organic solids, liquids, and gases. Manure contains all the inorganic nutrients needed by plants. Roughly, 90% of the dry matter in manure is organic waste material from animal digestion of feeds. The microbial population of animal waste is composed mainly of bacteria, fungi, actinomycetes, and protozoa. Significant decomposition of manure may occur in the feedlot if allowed to remain there long enough. Further decomposition occurs when applied to the soil. Manure should be plowed under to minimize N loss. Huge quantities of animal waste applied to the land may result in accumulation of some organic and inorganic constituents in concentrations that may become toxic to plants, particularly under anaerobic decomposition conditions.
(Christenbury-Iowa State)

0401 - D4

MANURE TRANSFORMATIONS AND FATE OF DECOMPOSITION PRODUCTS IN WATER,

Kansas Univ., Lawrence. Dept. of Civil Engineering.
Ross E. McKinney.
In: Agricultural Practices and Water Quality, 1970, Iowa State University Press, p 256-264. 15 ref.

Descriptors: *Anaerobic conditions, *Aerobic conditions, *Lagoons, Farm wastes, Odor, Aqueous solutions, Disposal, Microorganisms, Design criteria, Water pollution sources, Waste water treatment.
Identifiers: Oxidation ditch, Anaerobic lagoons, Aerated lagoons, Oxidation ponds.

With regard to aqueous treatment systems for animal manure, it is apparent that aqueous treatment systems are not desirable for animal waste except in special situations. The concentrated animal wastes are not normally mixed with water and can be handled best as solid wastes. Chicken houses have been designed to handle the waste as solids. However, confined hog houses have too much fluid manure for handling as solids. The oxidation ditch has proven satisfactory for handling hog waste. Treated hog manure must be returned to the soil for final disposal. The soil is the ultimate acceptor of all animal wastes. There is no reason that the oxidation ditch should not be satisfactory for treating cattle manure. The biological treatment will reduce only a small fraction of the total solids of the manure. This treatment destroys the obnoxious qualities and results in a material that is more satisfactory for disposal.
(Christenbury-Iowa State)

0402 - A3, A9

DISEASE TRANSMISSION OF WATER-BORNE ORGANISMS OF ANIMAL ORIGIN,

Minnesota Univ., St. Paul. Dept. of Veterinary Microbiology and Public Health.
Stanley L. Diesch.
In: Agricultural Practices and Water Quality, 1970, Iowa State University Press, p 265-285. 93 ref.

Descriptors: *Diseases, *Animal diseases, *Animal pathology, *Human diseases, Farm wastes, Pathogenic bacteria, Pathogenic fungi, Pathology, Viruses, Water transfer, Human pathology, Parasitism, Water pollution sources.
Identifiers: Disease transmission, Rickettsia.

An effort is made to indicate the potential epidemiologic significance based on the variability of the resistant characteristics of various kinds of pathogenic organisms and their potential for water transmission. The historical implication of water and disease is briefly reviewed. The current problems of disease transmission related to water is discussed. To document water's role as a vehicle in disease transmission, information gathered from a literature review was used. Specific disease entities are grouped by classification based on etiology of the causative organisms. Infectious diseases of animals and man caused by bacteria, Rickettsia, viruses, fungi, and parasitic organisms are discussed. (Christenbury- Iowa State)

0403 - B1

ANIMAL WASTE MANAGEMENT TO MINIMIZE POLLUTION,

Minnesota Univ., Minneapolis. Dept. of Agricultural Engineering.
J. A. Moore.
In: Agricultural Practices and Water Quality, 1970, Iowa State University Press, p 286-297. 35 ref.

Descriptors: *Farm wastes, *Management, Aerobic conditions, Anaerobic conditions, Disposal, Tertiary treatment, Pollutants, Liquid wastes, Lagoons, Sedimentation, Trickling filters, Water pollution sources, Waste water treatment.
Identifiers: Flushing gutters, Composting, Aerated lagoons, Oxidation ponds, Slatted floors, Screening.

Management of animal waste can be broken down into four separate functions: collection, storage, treatment, and utilization or disposal. The options available for each of these functions are described. Collection is divided into two types: wet or dry. The remaining management functions depend on the collection type used. Three basic treatment processes developed by the Civil Service Engineers that apply to animal manure are described. These

are: Primary treatment, Secondary treatment, and Tertiary treatment. Almost all of the utilization and disposal of animal manures will be through land application. The disposal systems that have been proven are presented. These include liquid manure disposal as well as solid manure disposal.
(Christenbury-Iowa State)

0404 - A4, C3

MOVEMENT OF AGRICULTURAL POLLUTANTS WITH GROUNDWATER,
Geological Survey, Raleigh, N.C.
Harry E. LeGrand.
In: Agricultural Practices and Water Quality, Iowa State University Press, Ames, 1970, p 303-313. 2 fig, 18 ref.

Descriptors: *Path of pollutants, *Farm wastes, *Water pollution sources, *Groundwater, *Agricultural chemicals, Fertilizers, Pesticides, Nutrients, Soil water, Soils, Seepage, Soil chemistry, Absorption, Soil mechanics, Water quality, Soil properties, Water wells, Water table, Environmental effects, Water chemistry, Infiltration.
Identifiers: *Agricultural pollutants.

The volume of groundwater polluted by plant nutrients, animal wastes, and pesticides appears to be small. Numerous small polluted zones of water occur in the upper part of the zone of saturation. Sufficient safeguards are available to minimize groundwater pollution to the extent that good agricultural practices should not be deterred. The unsaturated zone above the water table attenuates almost all of the foreign bodies that are potential pollutants of the underlying groundwater. Chemical fertilizers, animal wastes, and pesticides vary greatly in their tendency to degrade in ground environments. The following favorable environmental factors tend to reduce the changes of pollution of water from wells and springs: (1) A deep water table, which (a) allows for sorption of pollutants on earth materials, (b) slows subsurface movement of pollutants, and (c) facilitates oxidation or other beneficial 'die-away' effects. (2) Sufficient clay in the path of pollutants so that retention or sorption of pollutants is favorable. (3) A gradient of the water table beneath a waste site away from nearby wells. (4) A great distance between wells and wastes. (Woodard-USGS)

0405 - A3

EFFECTS OF AGRICULTURAL POLLUTION ON EUTROPHICATION,
Wisconsin Univ., Madison. Dept. of Sanitary Engineering, and Wisconsin Univ., Madison. Dept. of Water Chemistry.
D. E. Armstrong, and G. A. Rohlich.
Agricultural Practices and Water Quality, Iowa State University Press, Ames, Iowa, 1970, Chapter 23, p 314-330. 14 tab, 2 fig, 26 ref.

Descriptors: *Eutrophication, *Nitrogen, *Phosphorus, Nutrients, Algae, Nitrates, Surface runoff, Base flow, Percolation, Leaching, Drainage, Farm wastes, Soil management, groundwater, Wisconsin, Water supply.
Identifiers: *Agricultural drainage, Lake metabolism, Mobility, Particulate form, Feedlots, Nutrient sources.

The paper discusses nitrogen and phosphorus transport in agricultural drainage since these are the most important nturients involved in eutrophication. It is generally expected that inorganic nitrogen is transported mainly as nitrate by percolating water, although the amounts of ammonium and nitrate carried in runoff waters may be highly significant in terms of the receiving water. Similarly, the largest amount of phosphorus is likely transported in particulate form in runoff waters, but the amount of dissolved phosphorus in runoff water may be of equal or greater importance even though lower in quantity. The contribution of agricultural drainage to the nitrogen and phosphorus status of waters is next examined. The data presented suggest that agricultural land is an important contributor of nitrogen and phosphorus to water. About 60% of the nitrogen and 42% of the phosphorus were estimated to come from agricultural land. Nutrient budget estimations were based on data obtained on a small scale and extrapolated and thus have a low reliability. Nutrient sources are numerous and generalizations as to which source is the most important cannot be made. The contribution of agriculture should be reduced by improved and more efficient agricultural management practices. (White-Iowa State)

0406 - A3

EFFECTS OF AGRICULTURAL POLLUTANTS ON RECREATIONAL USES OF SURFACE WATERS,
Missouri Univ., Columbia. Dept. of Zoology; and Missouri Dept. of Conservation, Columbia.
Robert S. Campbell, and James R. Whitley.
Agricultural Practices and Water Quality, Iowa State University Press, Ames, Iowa, 1970, Chapter 24, p 331-343. 3 tab, 1 fig, 43 ref.

Descriptors: *Pollutants, *Recreation, Lakes, Streams, Algae, Pesticides, DDT, Return flow, Sediments, Soil erosion, Fertilizers, Farm wastes, Fish, Fish eggs, Turbidity, Nutrients, Dissolved oxygen, Nitrogen, Phosphorus, Water Quality Act, Water quality.

Unquestionably many agricultural pollutants affect recreation through alteration of water quality and degradation of fish and aquatic life. The more serious polluting agents are eroded soil, agricultural fertilizers, animal wastes, and pesticides. While the problems relating to agricultural pollution are complex, and the solutions will not easily be attained, it seems reasonable that in many instances alternative procedures can be developed. Pollution control measures are available which will allow continuation of agricultural production and enhance and protect water quality and recreation. While these procedures may be costly to apply, the expenditure should be judged in light of its contribution toward the preservation of man's environment. Especially in the instance of pesticide use, protection of water quality may be requisite to protection of the health of man from unknown long-term effects of pesticides. Reduction and control of agricultural pollutants are essential to develop and maintain a high quality environment. Quality of life and quality of environment are synonymous.
(White-Iowa State)

0407 - A3

EFFECTS OF SURFACE RUNOFF ON THE FEASIBILITY OF MUNICIPAL ADVANCED WASTE TREATMENT,
Iowa State Univ., Ames. Dept. of Civil Engineering.
Robert E. Baumann, and Sheldon Kolman.
Agricultural Practices and Water Quality, Iowa State University Press, Ames, Iowa, 1970, Chapter 25, p 344-362. 7 fig, 1 tab, 19 ref.

Descriptors: *Surface runoff, *Sewage treatment, Tertiary treatment, Biochemical oxygen demand, Industrial wastes, Farm wastes, Pollutants, Fertilizers, Nitrogen, Nitrates, Phosphorus, Phosphates, Algae, Eutrophication, Water quality, Rivers, Iowa, Corn, Discharge, Chlorophyll.
Identifiers: Industrial water pollution, Des Moines River, Packing plants.

The protection of the quality of water in Iowa streams requires that attention be directed at the various contributors of the significant pollutants. Attention is currently being directed at municipal and industrial wastes discharges, since these enter streams through a point source and are easily controlled. All such wastes must be given secondary treatment prior to discharge to Iowa's streams. As more stringent treatment requirements are demanded in the future, there is some question as to whether nutrient removals from municipal and industrial wastes will be sufficient to protect the stream. This study indicated that during periods of dry weather when light and turbidity conditions are favorable for phytoplankton growth, the principal source of the N and P required to support such growth is derived from municipal and industrial waste water discharges. Removal of N and P from such waste water discharges will help reduce phytoplankton growth. In periods of high stream flow, when turbidity levels are high enough to be unfavorable to phytoplankton growth, runoff from urban and rural lands and channel erosion are probably the principal contributors of N and P to the stream. Removal of N and P from municipal and industrial wastes during these periods will not reduce nutrient levels significantly. Under the latter conditions, tertiary treatment of municipal and industrial wastes will be of less benefit until runoff contributions of N and P are also controlled.
(White-Iowa State)

0408 - A3, F2

LEGAL ASPECTS,
Iowa Univ., Iowa City. Coll. of Law.
N. William Hines.
Agricultural Practices and Water Quality, Iowa State University Press, Ames, Iowa, 1970, Chapter 26, p 365-376. 26 ref.

Descriptors: *Legal aspects, *Water pollution, Farm wastes, Pesticides, Sediments, Fertilizers, Riparian rights, DDT, Water quality, Regulation, Water Quality Act, Standards, Administrative agencies, Pesticide residues, Soil erosion, Silting.
Identifiers: *Point sources, Common law, Nuisance, Feedlots, Registration.

The forec of the law has not been brought to bear on agriculture as it has on other major sources of water pollution. Agricultural pollution has thus far been ignored because it is less visible and more difficult to correct than are wrates from municipalities and industry. Currently only those types of agricultural pollution that are obvious and subject to direct control receive legal attention. As point sources are brought under control, agriculture's more subtle contributions to water pollution will attract regulatory concern. Public regulation of agricultural pollution will take two primary forms: (1) direct restrictions on the use of chemical inputs to agricultural production, and (2) regulation of land use patterns and practices. Examples of the first type of regulation are prohibitions or limitations on the use of certain chemical biocides, fertilizers, and other additives. Land use regulations seem very likely to be necessary to effect a meaningful reduction in soil erosion. The ideal construct might involve the employment of land-use controls by a comprehensive watershed management authority. If this does not come to pass, exercise of such powers by other local districts such as soil conservation districts, conservancy districts, or drainage districts would be feasible, as would granting similer powers to the local pollution control agency. (White-Iowa State)

0409 - F1

ECONOMIC ASPECTS,
Iowa State Univ., Ames. Dept. of Economics.
John F. Timmons.
Journal Paper No J-6469 of the Iowa Agricultural and Home Economics Experiment Station, Iowa State University, Ames, Iowa. Agricultural Practices and Water Quality, Iowa State University Press, Ames, Iowa, 1970, Chapter 27, p 377-389. 9 ref.

Descriptors: *Water quality, *Economics, Management, Water quality control, Water resources, Costs, Benefits, Standards, Measurement, Water

Quality Act.
Identifiers: *Quality levels, *Water supplies quality, *Water demand quality, Least cost method, Externalities, Public intervention, Water quality management, Quality use.

The first step toward meeting water quality management relating to water use within agriculture is being taken through becoming aware of the importance of water quality problems. The need to recognize the quality heterogeneities of water from demand and supply orientations is evident. The importance of demand orientations and requirements is paramount in specifying quality standards which vary among uses, spatially and temporally. Supply qualities must be geared to qualities demanded by uses. Least-cost methods are necessary in meeting demand qualities. In assigning benefits and costs to water uses, the problems of externalities, measurement, and intervention are crucial. Economics with its legacy of methods, theory, and its corps of resource economists is a necessary part of the multidisciplinary approach in planning and in carrying out relevant research necessary for education, legislation, and administration of water quality management. (White-Iowa State)

0410 - F3

ALLIANCE FOR ACTION,
Federal Water Pollution Control Administration, Kansas City, Mo. Missouri Basin Region.
John M. Rademacher.
Agricultural Practices and Water Quality, Iowa State University Press, Ames, Iowa, 1970, Chapter 28, p 390-396. 10 ref.

Descriptors: *Farm wastes, *Water pollution, Agriculture, Fishkills, Pesticides, Sediments, Runoff, Regulation, Zoning, Management, Waste treatment, Dissolved oxygen.
Identifiers: *Feedlots, *Technical base, *Inventory, Registration, Feedlot runoff, Animal waste management, Quantities, Runoff strength, Population equivalent.

The author chooses to look at animal wastes since this pollutant lends itself to more classical solutions than do other agricultural pollutants. He then pieces together the various interests involved with the animal waste problem. A technical base of information is required to establish effective controls. The development of an inventory noting animal production, concentration and location is an essential element of the technical base for the animal waste problem. Specific research and development needs must be delineated in accordance with the expected trends of the feedlot industry. Regulations are needed to ensure feedlot operators that measures they employ will guarantee a reasonable tenure of operation. Zoning regulations may be necessary and desirable. Mandatory registration should be an integral part of feedlot regulations. A sound animal waste management program encompasses prevention, reduction, treatment, and disposal of animal wastes. No one treatment process or system will be the solution for all animal production units. A variety of management and treatment systems will have to be developed. If it is the public who must bear the cost, then agriculture must have the courage to include waste treatment as a part of its production costs.
(White-Iowa State)

0411 - F4

ACCOMPLISHMENTS AND GOALS,
Federal Water Pollution Control Administration, Washington, D.C. Agricultural and Marine Pollution Control.
Harold Bernard.
Agricultural Practices and Water Quality, Iowa State University Press, Ames, Iowa, 1970. Chapter 29, p 397-407. 2 fig, 1 tab, 2 ref.

Descriptors: *Water pollution, *Water quality, *Standards, Environment, Research and development, Management, Water Quality Act, Nebraska, Water supply, Water utilization, Water sports, Pollution abatement, Biochemical oxygen demand, Sewage treatment, Farm wastes, *Nutrients, Return flow, Expenditures.
Identifiers: *Federal Water Pollution Control Administration, Agricultural pollution.

The article gives information as to the scope and extent of FWPCA activities relating to the control of agricultural pollution. Over $4 million has been expended in 1969 and 1970 on research and demonstrations involving pollution abatement from pesticides, nutrient runoff, irrigation return flows and feedlot operations. An example of criteria for water quality standards is given. Recommendations from a recent task force of seven cognizant Federal agencies studying the agricultural pollution problem are given. Data is presented indicating the need for municipal, industrial and agricultural pollution control. New techniques and systems must be developed to increase the quantity of pollutants removed from those sources before it reaches our streams. (White-Iowa State)

0412 - E3

THE INFLUENCE OF ASHED POULTRY MANURE ON SOIL, SNAP BEANS, AND TOMATOES,
Pennsylvania State Univ., College Park. Agricultural Experiment Station.
Charles A. McClurg, Ernest L. Bergman, and
Glenn O. Bressler.
Progress Report 312, April 1971, 9 p, 12 tab., 18 ref.

Descriptors: *Poultry, *Crop response, Farm wastes, *Waste treatment, Fertilizers, Soil analysis, Laboratory tests, Sampling.
Identifiers: *Ashed poultry manure, Waste reuse.

Four experiments were conducted to determine the growth of snap beans (phaseolus vulgaris L.) and tomatoes (lycopercson esculentum mill) in a Hagerstown clay loam soil containing various proportions of ground dried and/or ashed poultry manure. Addition of ash significantly increased soil pH, available P, and milliequivalents and percent saturation of K, Mg, Ca in the soil. Germination of bean seed in pot culture was severely restricted by the amounts of ash and/or dried manure added to the soil due to excessive concentrations of soluble salts, however, pod yield increased with low levels of ash and dried manure. Leaf analyses indicated increased K and Mg and decreased Ca content when ash had been added to the soil. Addition of dried manure resulted in increased foliar content of P, K, Ca, Mg, Mn, Fe, and Al. There was no significant reduction of stand or yield when snap beans were grown under field conditions on soil to which 30t/acre ash had been added although maturity of pods appeared to be slightly delayed. Foliar analysis of beans grown in soil treated with ash showed significant increases of K, Mg, B, Na in leaves, while Ca and Mn decreased significantly. Application of ash to field soils at a rate of 120t/acre resulted in the death of all tomato transplants and no weed growth. With 60t/acre a 45 percent morality and consequent reduction of yield were observed. Ashed poultry manure can definitely be used in crop production but only in conjunction with a soil test. (Hazen-Iowa State)

0413 - E3

VALUE OF PROCESSED POULTRY WASTE AS A FEED FOR RUMINANTS,
Pennsylvania State Univ., University Park.
F. F. El-Sabban, J. W. Bratzler, T. A. Long, D. E. H. Frear, and R. F. Gentry.
Journal of Animals Science, Vol 31, 1970, p 107-111. 5 tab, 16 ref.

Descriptors: *Ruminants, *Poultry, *Digestion, *Diets, Farm wastes, *Waste treatment, Nitrogen, Animal metabolism, Livestock, Laboratory tests.
Identifiers: Waste processing, Waste utilization, Heat treated poultry waste.

Heat treated poultry waste was evaluated as a source of nitrogen for ruminant animals. Poultry waste was subjected to three different heat treatments to produce autoclaved (APW), cooked (CPW), and dried (DPW) products. In a sheep metabolism trial, wethers were fed semi-purified rations in which nitrogen was supplied by APW, CPW, or Soybean meal. Digestibility coefficients for dry matter and energy were not significantly different among rations, but that of protein was significantly higher for the ration containing soybean meal (control) than of the ration containing APW. Urinary energy was significantly higher for the control ration than for the rations containing APW or CPW. Fecal nitrogen was significantly lower for the control ration than for the rations containing poultry waste products, no other significant differences were found. Twenty-five angus steers, divided into four groups, were used in a 134-day feeding trial, steers were fed finishing rations in which all supplemental nitrogen was provided by soybean meal, APW, DPW, or urea. Rate of gain and feed rations in which supplemental protein was provided by soybean meal, APW or DPW. Rate of gain was significantly higher for steers fed a ration containing urea than those fed the ration containing DPW. Carcass characteristics and meat acceptability were not significantly different among steers fed the different rations. Chlorinated hydrocarbon compounds in backfat and liver arsenic were found in amounts less than 1 PPM. (Hazen-Iowa State)

0414 — A1, F4

THE POLLUTION POTENTIAL OF CATTLE FEEDING OPERATIONS,
Investigations Leader, Northern Plains Branch, Fort Collins, Colorado.
F. G. Viets.
Montana State University Symposium on Agriculturally Related Pollution, February 10, 1970, Bozeman, Montana, pp. 11-16, 1 tab., 3 ref.

Descriptors: *Farm wastes, confinement pens, cattle, feedlots, groundwaters, odors, ammonia, dust, nitrates, air pollution, phosphorus, microbial,

The concentration of a large number of cattle into a very small space has created our problems of offensive odors in the air, runoff capable of polluting streams and killing fish, percolation of water to the water table making it hazardous to drink, and mountains of manure. Per capita beef consumption in the United States has increased about 3.5% a year over the last 20 years. At present, about 16 million cattle are fed annually. The pollution from runoff is an enormous problem in humid areas. The writer feels that adequate and economical solutions are not in sight, and that the economics of pollution control may force the cattle feeding industry into drier areas, even if grain must be hauled from the wetter grain producing areas. Air pollution from cattle feedlots includes odors, dust, and ammonia. Of these, only dust is being controlled to any great extent. Dust can be controlled to some degree by sprinklers. As to deep percolation, very little is known. However, nitrates in groundwaters in Missouri have been attributed to corrals. Other instances where wells are located close to feedlots, the water from the wells are unsuitable for drinking. It cannot be said that feedlots are polluting the water table with nitrates; however, the water under feedlots had an offensive odor and was enriched in ammonium and soluble organic and phosphorus compounds. (Bandy - ISU).

0415 - A5, D2

TURNING WASTES INTO PROFITS,
Earl D. Anderson.
Farm Quarterly, Vol 25, No 6, Nov-Dec 1970, p 48-85. 1 fig.

Descriptors: *Waste treatment, *Drying, Poultry, Odor, Waste storage.

Identifiers: Waste drying pit, Odor control, *Waste reuse.

The manure drying pit is a new concept in on-farm conversion of wastes to salable products. In the pit, circulating fans subject droppings to a continuous flow of drying air at an average velocity of 500 feet per minute. Also, the accumulated droppings are stirred and exposed to the drying air by a winch-drawn spike-toot- harrow. Periodically, the droppings are removed by means of a hinged cleanout board attached to the harrow. The partically dried manure can be stored indefinitely without developing an odor and without taking up moisture from the surrounding air. Controlling odors in the house provides a better environment for the birds and the attendants. (Hazen-Iowa State)

0416 - A3, A9, C2, C4, E2

A STUDY OF SOME DISEASE HAZARDS WHICH COULD BE ASSOCIATED WITH THE SYSTEM OF APPLYING CATTLE SLURRY PASTURE,

Agricultural Research Council, Compton (England). Inst. for Research on Animal Diseases.
J. Deans Rankin, and R. J. Taylor.
The Veterinary Record, Vol 85, November 22, 1969, p 578-581. 3 tab, 7 ref.

Descriptors: *Farm wastes, *Soil-borne diseases, *Slurries, Dairy cows, Waste water disposal, Soil contamination, Water pollution sources, Public health, Pollutant identification.
Identifiers: Bacterial survival.

Physical and bacteriological examinations of 16 samples of cattle 'slurry' have been carried out. On three occasions potentially pathogenic bacteria were isolated, namely, one strain of Salmonella dublin and two strains of haemolytic Escherichia coli. Five strains of potentially pathogenic bacteria survived for 11 to 12 weeks in slurry, although none of them appeared to multiply. The system of slurry disposal on pasture and its implications are discussed. (Hazen-Iowa State)

0417 - A2, C3

ACCUMULATION OF PHOSPHATES IN WATER,

Agricultural Research Service, Morris, Minn. North Central Soil Conservation Research Center.
Robert F. Holt, Donald R. Timmons, and Joseph J. Latterell.
Journal of Agriculture and Food Chemistry, Vol 18, No 5, p 781-784, 1970. 1 tab, 37 ref.
Descriptors: *Phosphates, *Path of pollutants, *Eutrophication, *Leaching nutrients, Fertilizers, Precipitation (Atmospheric), Runoff, Animal wastes, Surface waters, Soil erosion, Nutrients, Algae, Lake Superior, Water Pollution sources, Minnesota, Washington, Connecticut.
Identifiers: Illinois River, St. Louis River, Black River (Minnesota), Lake Washington (Washington), Linsley Pond (Connecticut), Lake Zoar (Connecticut), Lake Minnetonka (Minnesota), Big Stone Lake (Minnesota), Lake Crystal (Minnesota).

Natural and agricultural sources of phosphorus to surface waters include percipitation, animal wastes, fertilizers, and land runoff. The actual contribution from these sources is shown to be quite low. However, the concentration of phosphorus required to support profuse algal blooms is so low that the limited amounts supplied are sufficient to exceed this requirement. Eroded soil delivers appreciable amounts of phosphorus to surface waters, but the soil materials capacity to sorb phosphorus results in little tendency for release of this source into the water. Bottom sediments appear to be a sink for dissolved orthophosphate that is supplied to surface waters. Leaching of vegetation can supply relatively large amounts of phosphorus to lakes and streams. Deep incorporation of phosphatic fertilizers materially reduces the concentration of phosphorus in runoff waters as compared to shallow incorporation. Phosphorus concentrations in several lakes and streams are shown. (McCann-Battelle)

0418 — C5, E3

ENRICHMENT OF CATTLE MANURE FOR FEED BY ANAEROBIC FERMENTATION,

Auburn University.
J. D. Moore, W. B. Anthony.
Journal of Animal Science, Vol. 30, 1970, pp. 334.

Descriptors: *Waste identification, Farm wastes, Cattle, Toxicity, Amino Acios, Feeds, Proteins, nitrogen.
Identifiers: *Organic Acid Synthesis, Toxicity trials.

It was determined that by fermenting cattle manure under anaerobic conditions organic acid synthesis occurred and the pH of the fresh manure dropped from 6.25 within 16-½ hours when incubated at 37°C. By adjusting pH with ammonia once every 24 hours for 3 days, the apparent crude protein level as determined by Kjeldahl Nitrogen analysis, increased from 16.99% to 43.26%. There was a net increase in amine acids greater than 20%. Organic acids (%DM) were acetic acid, 7.20; propionic acid 1:27; butyric acid, 1.34%, valeric acid, 0.11; and eactic acid, 16.83%. From palatability tests with lambs, rations containing either manure or ammonium lactate were equal. In toxicity trials using sheep, ammonium acetate was more toxic than urea. Dosages were made isonitrogenous with urea at the level of 0.88 urea/kg body weight, (Hazen - ISU).

0419 — A8, C5, D4, E3

DIGESTION OF POULTRY MANURE BY DIPTERA,

Colorado State University, Department of Avian Science, Fort Collins.
B. F. Miller, J. H. Shaw.
Poultry Science, Vol. 48, No. 5, pp. 1844-1845, 1969.

Descriptors: *Diptera, Farm wastes, Poultry, Waste treatment, Waste disposal.
Identifiers: *Musca domestic, Muscina Stabulans.

Five species of Diptera were tested for their ability to properly grow, develop, and reproduce in fresh poultry manure. **Musca domestica** and **Muscina stabulans** were the two species found to be the most promising. Musca, with its high biological potential, effectively reduces poultry manure to a more stable product. This species will develop from egg to pupa in five to six days at 37°C. The larvae may be harvested by spreading the manure thinly on a screen under an intense light source. Because they are photonegative they will crawl through the screen permitting collection below. If they are permitted to develop to the pupa stage, the pupa can be separated from the manure residue by flotation. These larvae removed about 80% of the organic matter from fresh poultry manure in five to six days. The moisture content was reduced from 75 to 50% simultaneously. About 25 to 30 grams of larvae was produced from each kilogram of fresh poultry manure. (Hazen - ISU).

0420 - C4

SOME EFFECTS OF ORGANIC WASTES ON AQUATIC INSECTS IN IMPOUNDED HABITATS,

Louisiana State Univ., Baton Rouge. Dept. of Entomology., and Louisiana State Univ., Baton Rouge. Dept. of Microbiology.
C. D. Steelman, and A. R. Colmer.
Annals of the Entomological Society of America, Vol 63, No 2, p 397-400, 1970. 3 tab, 4 ref.

Descriptors: *Water pollution effects, *Organic wastes, *Aquatic insects, Habitats, Impounded waters, Coliforms, Mosquitoes, Lagoons, Indicators, Livestock, Water pollution sources.
Identifiers: Swine, Lagoon studies, Culex pipiens quinquefasciatus, Escherichia coli, Escherichia freundii, Escherichia intermedia, Aerobacter aerogenes, Coptotomus, Hydrous triangularis, Chironomus plumosus, Chaoborus, Brachydeutera, Musca domestica, Psychoda, Hermetia illucens, Stratiomys, Eristalis aeneus, Tabanus, Odonata.

The relative effects of organic waste pollution on the aquatic insect fauna of a freshly dug livestock waste disposal lagoon was studied. Introduction of organic waste material from swine pens into impounded aquatic habitat caused suppression of certain insect species. Decreases in aquatic insect fauna paralleled the increase in the organic waste concentration determined by changes in the numbers of coliform bacteria. The southern house mosquito, Culex pipiens quinquefasciatus Say, began laying eggs in the lagoon when coliform counts approximated 7000 organisms per milliliter of lagoon water. Water suspensions of pure cultures of coliforms Escherichia coli, E freundii, and E intermedia were found to be more attractive as oviposition sites for C p quinquefasciatus than water suspensions of Aerobacter aerogenes or sterile water. The change in insect fauna in the new lagoon during the 2-1/2 years' study was considered to be directly related to the change in the organic waste pollution of the water. The data obtained indicate the possibility of using aquatic insects as biological indicators of water quality. (Jones-Wisconsin)

0421 - E3

EFFECTS OF MANURE APPLICATIONS AND MITE PREDATION ON CORN ROOTWORM POPULATIONS IN MINNESOTA,

Minnesota Univ., St. Paul. Dept. of Entomology, Fisheries and Wildlife.
H. C. Chiang.
Journal of Economic Entomology, Vol 64, No 3, June 1970, p 934-936. 3 tab, 4 ref.

Descriptors: *Mites, *Disposal, *Predation, Farm wastes, Laboratory tests, Soil treatment, Soil analysis, Soil tests, Population, Corn (Field), Distribution patterns, Water pollution effects.
Identifiers: *Corn rootworms, *Predaceous mites, Manure application, Soil test plots.

Manure was applied in corn plots in 1967 at the rate of 50 tons per acre. The northern and western corn rootworms, Diabrotica longicornia (Say), and D. virgifera LeConte, populations in these plots were reduced to about half the level of those in the check plots. Quantitative observations of the predaceous arthropods in the manured and the check plots showed that the total populations of ground beetles and spiders were not changed because of the manure application. However, the populations of mites, both predaceous and non-predaceous, were 3 or more times as high in the manured as in the check plots. On the basis of the vertical distribution of these mites and of corn rootworms, it was concluded that the predaceous mites could be feeding on corn rootworms. The data suggested that predation by mites accounted for a 19.7% control of corn rootworms under natural field conditions and a 63.0% control when manure was applied in the field. (Hazen-Iowa State)

0422 - C2, C3, E3

PROTEIN AND ENERGY VALUE OF PEANUT HULL AND WOOD SHAVING POULTRY LITTERS,

Virginia Polytechnic Inst. and State Univ., Blacksburg.
Asok Nath Bhattacharya, and J. P. Fontenot.
Journal of Animal Science, Vol. 25, p 367-371, 1966, 5 tab, 20 ref.

Descriptors: *Feeds, *Peanuts, Diets, Animal metabolism, Digestion, *Farm wastes, Wood wastes, Proteins, Metabolism, Amino acids,

*Waste disposal.
Identifiers: Total digestible nutrient, Digestive coefficients, Hulls, Shavings, Litter, Chemical composition, Feeding trials.

Three digestion and metabolism trials were conducted with 10 yearling wethers to study the protein and energy value of autoclaved peanut hull and wood shaving broiler litters, when each was incorporated at levels of 25 and 50% in a corn-hay basal ration. Apparent digestibility of crude protein was not significantly different among rations. Crude fiber digestibility of the litter rations was higher ($P < .01$) than that of the control ration. Dry matter, NFE and energy digestibility were lower ($P < .01$) when the litter level in the ration was increased from 25 to 50%. (Hazen-Iowa State)

0423 - F4
2ND COMPENDIUM OF ANIMAL WASTE MANAGEMENT.
Federal Water Pollution Control Administration, Kansas City, Mo. Missouri Basin Region.

June 1969. 256 p, 59 tab, 33 fig, 80 ref.

Descriptors: *Farm wastes, Rainfall-runoff relationships, Legislation, *Water quality, Pollutant identification, Disposal, Runoff, Grants, Cattle, Land use, Fertilizers, Management, Economics, Nutrients, Storage, Pollution abatement, Eutrophication, Design data, Erosion.
Identifiers: Feedlot wastes, Pollution potential, Nitrate movement, FWPCA, Population equivalents, Processing, Feedlot size, Feedlot runoff, Basin-wide planning.

Twelve papers were presented at the meeting. Major emphasis was placed on cattle feedlot pollution potential. Various aspects of the pollution caused by animal waste were discussed. Sources of pollutants and effects on water quality were emphasized. History and characteristics of animal waste pollution were discussed. Methods for minimizing pollution and the economics of disposal were considered. (Christenbury-Iowa State)

0424 - A2, A4, F3
ANIMAL WASTE RUNOFF - A MAJOR WATER QUALITY CHALLENGE,
Federal Water Pollution Control Administration, Kansas City, Mo.
A. V. Resnik, and Rademacher.
In: 2nd Compendium of Animal Waste Management, June 1969, Paper No 1. 21 p, 26 ref.

Descriptors: *Runoff, Farm waste, Legal aspects, Eutrophication, Groundwater, Water quality, Biochemical oxygen demand, Pollutant identification, Water pollution control.
Identifiers: Feedlot runoff, Population equivalents, Pollution potential.

An overview is presented of the causes and effects of animal waste pollution on water quality. The extent of the problem as well as the effects on surface and ground waters are illustrated with research data. The present status of legislation in regulatory control of pollution is discussed. Measures to strengthen present regulations are proposed.
(Christenbury-Iowa State)

0425 - A2, C5
ANIMAL WASTES–A MAJOR POLLUTION PROBLEM,
Iowa Univ., Iowa City. Dept. of Civil Engineering.
R. R. Dague.
In: 2nd Compendium of Animal Waste Management, June 1969, Paper No 2. 14 p.

Descriptors: *Farm wastes, Biochemical oxygen demand, Chemical oxygen demand, Hogs, Cattle, Iowa, Runoff, Disposal, Management, Rainfall-runoff relationships, Retention, Water pollution control.
Identifiers: *Livestock wastes, *Characteristics, *Feedlots runoff, Population equivalents, Swine, Site selection, Trends, Animal stocking rates.

The water pollution potential of livestock wastes is discussed. The characteristics of animal wastes are discussed. The major source of water pollution from livestock is open feedlots. The control fundamentals that apply to open feedlots are discussed. Feeding facilities must be designed and operated not only to optimize meat production but also to minimize pollution. (Christenbury-Iowa State)

0426 - A2, A4, B1, F2
REGULATORY ASPECTS OF FEEDLOT WASTE MANAGEMENT,
Kansas State Dept. of Health, Topeka. Environmental Health Services.
M. W. Gray.
In: 2nd Compendium of Animal Waste Management, June 1969, Paper No 3. 38 p, 14 tab.

Descriptors: *Legal aspects, Public health, *Legislation, *Fishkill, *Rainfall-runoff relationships, Farm wastes, Aquatic life, Water supply, Recreation, Management, Biochemical oxygen demand, Dissolved oxygen, Regulation, Cattle, Odor, Retention, Kansas, Water pollution control, Water pollution effects.
Identifiers: *Waste characteristics, *Feedlot runoff, Pollution potential, SHUD, Health aspects, Nuisances, Pollution control, Retention ponds.

The legal and environmental implications of pollution from cattle feedlots is discussed. A table is included that summarizes the fish kills that have been attributed to feedlot runoff in Kansas. Chapter 28, Article 18, of the Kansas State Board of Health Regulations is included. The author discusses methods for minimizing pollution of surface and groundwater from feedlots.
(Christenbury-Iowa State)

0427 - E2
MANAGEMENT OF ANIMAL FEEDLOT WASTES – LAND SPREADING AS A DISPOSAL PROCESS,
Missouri Univ., Columbia. Water Resources Research Center.
G. E. Smith.
In: 2nd Compendium of Animal Waste Management, June 1969, Paper No 4. 8 p.

Descriptors: *Management, *Farm waste, *Disposal, *Land use, Cattle, Fertilizers, Costs nutrients, Waste disposal, Water pollution control.
Identifiers: Nutrient removal, Application rate.

Disposal of animal waste onto land is effective and can increase crop yields. Attention must be given to the condition of the waste and supplemental nutrients added to insure a balanced fertilizer program. Cost of land disposal may exceed returns in terms of crop response, however land disposal can minimize animal waste disposal costs.
(Christenbury-Iowa State)

0428 - A2, F4
DESIGN FOR FEEDLOT WASTE MANAGEMENT - HISTORY AND CHARACTERISTICS,
Kansas State Univ., Manhattan. Dept. of Agricultural Engineering.
R. I. Lipper.
In: 2nd Compendium of Animal Waste Management, June 1969, Paper No 6. 9 p, 4 tab.

Descriptors: *Farm wastes, *Rainfall-runoff relations, *Pollution abatement, Biochemical oxygen demand, Runoff, Nutrients, Dissolved oxygen, Soil structure, Irrigation, Nitrogen, Detention reservoirs, Water pollution control.
Identifiers: *Feedlots, Pollution potential, Kjeldahl nitrogen.

The purpose is to illustrate the value of the cattle feeding industry to the state of Kansas; to relate its growth in the state to the emergence of a water pollution problem; and to make an attempt to describe the nature and magnitude of the problem in the best perspective that can be achieved at this time. Large-scale cattle feeding is a growth industry suited to Kansas resources and one that the state can ill afford to ignore. Efficient livestock production methods have given rise to water pollution problems. Pollutant concentration is approximately twice as great from a concrete lot as from an unsurfaced lot. Data is presented to evaluate the pollution potential of feedlot runoff.
(Christenbury-Iowa State)

0429 - A2, A3, A4, B1, C3
CONTRIBUTION OF FERTILIZERS TO WATER POLLUTION,
Missouri Univ., Columbia. Water Resources Research Center.
G. E. Smith.
In: 2nd Conpendium of Animal Waste Management, June 1969, Paper No. 7, 16 p, 7 tab, 5 fig, 24 ref. PHS-FWPCA-USDI - WP00533.

Descriptors: *Eutrophication, Fertilizers, Farm wastes, Nutrients, Denitrification, Nitrification, Ammonification, Leaching, Erosion, Nitrogen, Runoff, Water pollution control, Groundwater, Septic tanks, Management.
Identifiers: *Methemoglobin, Nitrate movement, Feedlots, Residual accumulation, Soil cores.

Without chemical soil amendments the United States would be a food importing nation. Despite liberal fertilizer use, crops are removing more nitrogen and minerals than are being added in soil amendments. Many shallow wells in Missouri are contaminated with nitrates as a result of leaching from livestock feeding operations. The nitoate is not associated with losses from fertilized farm fields in most cases. There is little question that some of the nutrients applied in chemical fertilizers are moving into both surface and ground water; the percentage is thought to be relatively small. It is possible that nutrient losses may be less where good fertilization practices are followed than on unfertilized soils. (Iowa State)

0430 - A2, C1
CATTLE FEEDLOT WATER QUALITY HYDROLOGY,
Colorado State Univ., Fort Collins. Dept. of Agricultural Engineering.
T. E. Norton, and R. W. Hansen.
In: 2nd Conpendium of Animal Waste Management, June 1969, Paper No. 8, 26 p, 14 fig, 2 tab, 13 ref.

Descriptors: *Rainfall-Runoff relationships, *Liquid wastes, *Biochemical oxygen demand, Farm wastes, Dissolved solids, Hydrogen ion concentration, Alkalinity, Equipment, Simulated rainfall, Hydrology, Hydrographs, Rainfall intensity, Overland flow, Design data, Conductivity, Model studies, Water pollution control.
Identifiers: *Feedlot wastes, Pollution potential, Feedlots, Prediction method, Procedure.

Runoff wastewater from cattle feedlots is considered; the overall objective was to determine if the hydrology characteristics could be correlated with the quality characteristics through a modification of the flat plate model of overland flow. The results of the correlation could then be used to predict the quantity and quality of the runoff from existing feedlots. The data demonstrated the fact that the prediction method proposed requires extrapolation of data beyond the observed values. Therefore, additional information obtained from

studies of runoff from full-scale feedlots would be advisable in determining the validity of this extrapolation. (Christenbury- ISU)

0431 - F4
MAJOR PROBLEMS OF WATER POLLUTION CREATED BY AGRICULTURAL PRACTICES,
Federal Water Pollution Control Administration, Kansas City, Mo.
Walter F. Roboha.
In: 2nd Compendium of Animal Waste Management, June 1969, Paper No. 9, 16 p.

Descriptors: *Farm wastes, *Erosion, *Water pollution sources, *Pollution abatement, Runoff, Pollutants, Sediment, Livestock, Legal aspects, Legislation, Sugar beets, Farm lagoons, Fertilizers, Salts, Irrigation, Ground water, Pollution identification, Tailwater, Water pollution effects, Water quality control.
Identifiers: *Population equivalents, Feedlots, Slaughter, Processing.

This paper discusses the magnitude of the water pollution abatement problem facing agriculture. The major acitivity which is contributing to water pollution is discussed. Sediment derived from land erosion constitutes by far the greatest mass of all the waste material arising from agriculture. The fundamentals of pollution of interest to agriculture are discussed. The control of pollution from agricultural sources is severly handicapped by lack of knowledge. It will take the combined efforts of engineers, waste treatment plant operators, city officials, agricultural people and citizens in general to solve the great national problem of water pollution. (IowaState)

0432 - F1, F2
AGRICULTURE AS A SOURCE OF WATER POLLUTION,
Federal Water Pollution Control Administration, Charlottesville, Va. Middle Atlantic Region.
Eugene T. Jensen.
In: 2nd Conpendium of Animal Waste Management, June 1969, Paper No. 10, 11 p.

Descriptors: *Legislation, *Grants, Farm wastes, Nutrients, Sediment, Chemicals, Livestock, Water quality control, Pollution abatement, Federal Government, Disposal, Research and development.
Identifiers: *FWPCA, Basin-wide planning.

Various aspects of water pollution are discussed, including sources, types of pollutants, and methods of pollution abatement. The role that the Federal Water Pollution Control Administration plays in pollution control is discussed. Research grants and contracts are awarded to support basic and applied research projects relating to the causes control, and prevention of water pollution. The need for clean and usuable water demands that we build the cost of clean water into all our operations.
(Iowa State)

0433 - A2, A3, B1
EFFECT OF AGRICULTURE ON WATER QUALITY,
Federal Water Pollution Control Administration, Evansville, Ind. Lower Ohio Basin Office.
T. R. Smith.
In: 2nd Compendium of Animal Waste Management, June 1969, Paper No. 11, 11 p, 9 ref.

Descriptors: Water quality control, *Nutrients, *Pesticides, Farm wastes, Silt, Erosion, Sedimentation, Runoff, Fertilizers, Nitrogen, Phosphorus, Algae, Livestock, Water pollution effects.
Identifiers: Feedlots, Wabash River Basin.

The main sources of agricultural associated water pollution in humid regions are: (1) silt from soil erosion; (2) fertilizers, mainly phosphorus and nitrogen compounds (3) pesticides; and (4) organic wastes from feedlots. In arid regions, irrigation return flows are a problem. This paper discusses the effect of each of these sources can have on water quality and suggests some preventative measures. It is necessary that agriculturalists plan to control pollutional effects on their activity. (Christenbury-ISU)

0434 - A2, B1, D2, E2
ECONOMICS OF WATER POLLUTION CONTROL FOR CATTLE FEEDLOT OPERATIONS,
Texas Tecnological Coll., Lubbock. Dept of Agricultural Economics.
T. R. Owens, and Wade L. Griffin.
In: 2nd Compendium of Animal Waste Management, June 1969, Paper No. 12, 62 p, 31 tab, 2 fig, 8 ref.

Descriptors: *Economic feasibility, Rainfall-runoff relationships, *Disposal, *Cost comparisons, Economics of Scalo, Farm wastes, Runoff, Design criteria, Legal aspects, Costs, Biochemical oxygen demand, Evaporation, Model studies, Hydrological data, Equipment, Detention reservoirs, Odor, Systems analysis, Groundwater, Seepage, *Water pollution control.
Identifiers: *Feedlot size, Playa lake disposal, Open field disposal, Overflows, Feedlot runoff.

The economic feasibility of various methods for controlling or disposing of feedlot runoff is determined. The various design criteria were applied to three different sizes of model feedlots: (1) 5000 head, (2) 10,000 head, and (3) 25,000 head. The approach to the problem of water pollution from feedlots used here involved control of runoff by establishing collection basins and subsequently discharging the runoff to one of two disposal areas or alternatively to hold the collected runoff until natural evaporation emptied the system. In general, evaporative discharge systems were considered inferior to their mechanical counterparts because of the lower degree of protection provided and the rather extensive land requirements for construction of the collection basin. (Iowa-State)

0435 - A1, F4
THE MOUNTING PROBLEM OF CATTLE FEEDLOT POLLUTION,
Frank G. Viets, Jr.
Agricultural Science Review, Vol 9, No 1, First Quarter 1971, p 1-8. 2 figs, 2 tab, 13 ref.

Descriptors: *Waste disposal, *Waste dumps, Farm wastes, Solid wastes, Air pollution, Runoff, Water pollution control.
Identifiers: *Feedlot pollution, Solid waste disposal, Soil pollution.

Steadily increasing demands for well-finished beef and the apparent profitability of large integrated feeding and slaughtering operations indicate that feed lots will grow larger and not smaller. Cattle feeding is moving from a small farm enterprise toward an agricultural industry. This results in a large concentration of wastes on a small area. Most large operators are making an effort to comply with water and air pollution regulations. Because stream and lake pollution from runoff is now prohibited, engineers are challenged to design facilities that minimize runoff or dispose of it economically and, hopefully, beneficially. Runoff control is much more difficult in humid climates than in drier ones. Underground water pollution appears to be mostly a local phenomenon. Most of the unsolved problems lie in the air pollution area. Offensive odor and their control still await thorough application of microbiological and chemical research. Manure can be disposed of and used as a resource if only a small portion of the land needed to produce the feed is available for manure disposal. Zoning appears to be one of the best solutions to the feedlot problem. (Hazen-Iowa State)

0436 - A6, C1, C2
POULTRY DUST: ORIGIN AND COMPOSITION,
Auburn Univ., Ala. Agricultural Experiment Station.
J. Koon, J. R. Howes, W. Grub. and C. A. Rollo.
Agricultural Engineering, Vol 44, No 11, November, 1963 p. 608-609. 4 fig.

Descriptors: *Dusts, *Farm wastes, Poultry, Environmental effects.
Identifiers: Environmental control, Dust composition.

Dust is a major problem in poultry environmental control as it impairs the operational efficiency of equipment to a degree that its use becomes impractical. A study was made to determine the composition of poultry dust and to establish the effects of temperature on the dust producod. Single comb H3W white Leghorn laying hens were exposed to constant temperatures of 50, 60, 70, 80, 90, 100F. Broiler tests were conducted using ventress male cross No. 50 arbor acres female Whiterock chicks. Qualitative and quantitative dust samples were obtained and tested. The dust from laying hens contained approximately 92% dry matter, of which 60% was crude protein. Fat analysis was 9%, cellulose 4%. The remainder of the dry matter was ash and hydrocarbons. The broiler dust was lower in fat and higher in protein. Birds raised on litter have a decline in dust production at 90F. Relative humidity for all environmental chambers was 60%. (Hazen-Iowa State)

0437 - C1
PROPERTIES OF FARM ANIMAL EXCRETA,
E. P. Taiganides, and T. E. Hazen.
ASAE Paper No. 64-315. Transactions of the american society of agricultural engineers, Vol. 9, p 374-376, 1966. 6 tab, 13 ref. Iowa Agricultural and Home Economics Experiment Station Project 1433.

Descriptors: *Farm wastes, *Physical properties, *Chemical properties, Biochemical oxygen demand, Chemical oxygen demand, Livestock, Disposal, Gases, Odor, Biodegradation, Fertilizers, Value, Nutrients, Pollutant identification.
Identifiers: Population equivalents, Handling.

Data on the most important of the physical, chemical, and biological properties of poultry swine and cattle excreta have been reported, analyzed and discussed as to their value in the design of manure treatment facilities. The distinction is made between sewage and manure. Feed influences the quantity of waste and its chemical composition. Little work has been done recently to determine the physical properties of animals wastes. The daily production of manure from farm animals varies considerably. The questions is raised if it pays to collect and use animals manures as fertilizer. The availability of manure handling devices and disposal problem of wastes indicates justification of application to soils. Poultry manure has highest fertilizer value, swine is next. The biochemical oxygen (BOD) test is used to determine pollutional strength of an organic waste in terms of the oxygen demand that the waste will exert on a water body if discharged into anatural watercourse in which aerobic conditions must be maintained. The chemical oxygen demand (COD) test is also used as an index of strength of waste. A comparison is made of BOD and COD production mean values for man, hens, swine, and cattle. There is a lack of information on the composition of the gases, and on the control of odors produced as a result of the uncontrolled biological degradation of manures. (Hazen-Iowa State)

0438 - B1

SOIL CHEMICAL CHANGES AND INFILTRATION RATE REDUCTION UNDER SEWAGE SPREADING,
Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio.
R. E. Thomas, W. A. Schwartz, and T. W. Bendixen.
Soil Science Society of America Proceedings, Vol 30, 1966, p 641-646. 11 fig, 3 tab, 18 ref.

Descriptors: *Infiltration, *Lysimeters, Waste water treatment, Waste water disposal, Permeation, Chemical oxygen demand, Anaerobic conditions, Biochemical oxygen demand, Aerobic conditions, Disposal, Laboratory tests.
Identifiers: *Soil-pore clogging, Applied sewage effects, Microbial activity, Infiltration rate.

Laboratory and field lysimeters were used to investigate the site and nature of soil-pore clogging under sewage spreading. The site of clogging was located by determining with a seepage meter the impedance profile at 0.5-cm depth intervals. Soil samples were analyzed for sulfide, iron, phosphate, total organic matter, polysaccharide and polyuronide to evaluate possible causative relationships. The infiltration rate loss exhibited three phases: Phase I, a slow reduction under aerobic conditions; Phase II, a rapid reduction under anaerobic conditions; and Phase III, a further gradual decline under anaerobic conditions. The primary site of clogging was the 0-1-cm depth of soil. Although sulfide was an indicator of anaerobic conditions it was not a primary cause of clogging. Accumulations of the other five measured constituents may contribute to clogging in both Phase I and Phase II. Organic matter was the only probable clogging agent to decline as the infiltration rate was partially recovered in a rest cycle. (Hazen-Iowa State)

0439 - C4, D4

THE DECOMPOSITION OF URIC ACID IN BUILT UP POULTRY LITTER,
Edinburgh Univ. (Scotland). School of Agriculture; and Edinburgh Univ. (Scotland). Dept. of Bacteriology.
Henrietta E. Schefferle.
Journal of Applied Bacteriology, Vol 28, No 3, 1965, p. 412-420. 1 tab, 6 ref.

Descriptors: *Farm wastes, *Decomposing organic matter, *Bacteria, Poultry, Aerobic bacteria, Nitrogen, Water pollution sources.
Identifiers: *Uric acid decomposition, Coryneform bacteria, Urease activity, Ammonia formation.

The decomposition of uric acid in built up poultry litter appears to be brought about almost exclusively by the action of aerobic bacteria. Organisms decomposing uric acid usually comprised about one quarter of the bacterial population. There were strains of coryne bacterium and less frequently strains of NOCARDIA, STREPTOMYCES, PSEUDOMONAS, ALCALIGENES, and ACHROMOBACTER. Uric acid was converted to ammonia by some of the organisms but only to urea by the majority. Hydrolysis of urea to ammonia could be brought about by strains of corynebacterium, Micrococcus, Alcaligines, Achromobacter, and cytophaga which had no action on uric acid. It is suggested that the ammoniacal smell and high alkalinity of built up poultry litter result largely from the decomposition of uric acid. The identity of the bacteria concerned is discussed. (Hazen-Iowa State)

0440 - F2

LEGAL ASPECTS PERTAINING TO ENVIRONMENTAL REGULATIONS IN PORK PRODUCTION,
Missouri Univ., Columbia. Dept. of Agricultural Economics.
Donald R. Levi.
American Pork Congress - Proceedings, Environmental Quality Workshop, Des Moines, Iowa, Mar 3, 1971. p 103-111.

Descriptors: *Farm wastes, *Legal aspects, Water pollution, Air pollution, Public rights, Regulation, Judicial decisions, Damages, Zoning, Permits, Maintenance, Water pollution control.
Identifiers: Public regulation, Private regulation, Nuisances, Legal principles, Lawsuits, Liability, Actual damages, Punitive damages, Site selection.

Public and private regulation of both air and water pollution is provided by pollution boards or commissions and through nuisance laws. Two lawsuits are discussed so that the legal principles involved might help determine what courses of action will help avoid such situations. In a nuisance law case the complaining party may ask for (1) an injunction, (2) damages (either actual or punitive), or (3) both an injunction and damages. The nuisances involved may be either public or private. A plaintiff may have a better chance if the rights of the public are being affected. Methods of avoiding lawsuits include the use of zoning, site selection, licensing, proper maintenance, adequate facilities, and being a 'good neighbor.' (White-Iowa State)

0441 - C3

METHODS OF SAMPLE PREPARATION FOR CHEMICAL DETERMINATION OF CHROMIC OXIDE IN BOVINE FECES,
Kentucky Univ., Lexington. Dept. of Animal Science.
P. R. Utley, N. W. Bradley, and J. A. Boling.
Journal of Dairy Science, Vol 54, No 7, p 1091-1093, July 1971. 1 tab, 11 ref.

Descriptors: *Animal waste, *Chromium, *Nutrient, Chemical analysis, Laboratory, Indicators, Diurnal, Digestion, Statistical method, Time series analysis, Diet.
Identifiers: *Corn-urea diet, Blender, Chromium oxide, Feces, Fecal recovery, Ground corn.

Fecal samples were prepared by four different methods to observe the variation and per cent recovery of added chromic oxide with each method. Variation was greatest in the samples dried and ground with a Wiley mill and those homogenized and analyzed wet. The standard errors of the samples dried and ground with a hand grinder and those homogenized and analyzed dry were lower than those of the other two groups of samples. The average per cent recovery ranged from a low of 98.8% (homogenized, analyzed wet) to a high of 100.2% (homogenized, analyzed dry). The variation in chromic oxide concentration tended to be greater in samples containing the highest per cent moisture at time of analysis. (Bundy-Iowa State)

0442 - A5, B2, F1

CAN LIME AND CHLORINE SUPPRESS ODORS IN LIQUID HOG MANURE,
Illinois Univ., Urbana. Dept. of Agricultural Engineering.
C. W. Hammond, D. L. Day, and E. L. Hansen.
Agricultural Engineering, Vol 49, No 6, p 340-343, June 1968. 4 fig, 8 tab.

Descriptors: *Lagoons, *Anaerobic bacteria, *Chlorination, *Hydrated lime, Sand filters, Moisture content, Biochemical oxidation demand, Chemical oxidation demand, Swine, Air circulation, Organic waste, Evaporation, Hydrogen ion concentration, Odor.
Identifiers: *Hog confinement building, Slatted floors, Experimental farm, Liquid hog manure.

Liquid manure collected in pits beneath self-cleaning slatted floors supports anaerobic bacteria that produce objectionable gases and odors in the hog confinement building. Studies were instituted to check the use of lime and chlorine for preventing the production of these odors. The studies indicated that hydrated lime reduced the production of hydrogen sulfide, but to a lesser extent than the chlorine. It did not prevent the liberation of ammonia. The hydrated lime required to maintain the desired pH would cost $0.62 per hog for 6 months at $2.20 per 100 lb. Chlorine treatment is an effective deterrent of ammonia, hydrogen sulfide, methane and carbon dioxide. The cost of adding enough chlorine to fill the chlorine demand is about $6.40 per hog for 6 months, based on a cost of $0.54 per gal. for the sodium hypochlorite. Chlorine and lime were also effective in controlling maggots and rodents in the building. Chlorine seemed most effective. Sand-bed filtering was also found effective in trapping solids and organic matter. Fewer than 5 per cent of the solids penetrated the sand to any significant depth, the largest portion being left on surface. (Brundy-Iowa State)

0443 - C4, D4

SULFUR BACTERIA IN RED LAGOONS,
Nebraska State Dept. of Health, Lincoln. Div. of Environmental Engineering.
O. Sletten, and R. H. Singer.
Journal Water Pollution Control Federation, Vol 43, No 10, October 1971, p 2118-2122. 27 ref.

Descriptors: *Lagoons, *Sulfur bacteria, *Pigments, Oxidation lagoons, Farm wastes, Aerobic conditions, Anaerobic digestion, Anaerobic bacteria, Waste water treatment.
Identifiers: Red pigmentation, Thiorhodaceae.

Widespread investigations demonstrate that various genera of photosynthetic sulfur bacteria of the family Thiorhodaceae are usually responsible for red pigmentation in anaerobic easte stabilization lagoons. A number of these genera display only slight differences in morphology. Further taxonomic study may reveal that such differences represent nothing more than environmental reactions of a single genus. From observations and experience relating to the photosynthetic sulfur bacteria, the authors concur with other investigators on the possible practical role of these organisms in anaerobic waste lagoons. If the organisms are not naturally present in the lagoon, it has been recommended that they be introduced into it by massive inoculation. Their practical value lies in their potential ability to destroy reduced sulfur compounds and eliminate or reduce offensive odors. (Parker-Iowa State)

0444 - A2, C4

PROLONGED SALMONELLA CONTAMINATION OF A RECREATIONAL LAKE BY RUNOFF WATERS,
Wisconsin Univ., Madison; Medical School. Wisconsin State Lab. Hygiene, Madison.
D. G. Claudon, D. I. Thompson, E. H. Christenson, G. W. Lawton, and E. C. Dick.
Applied Microbiology, May 1971, Vol 21, No 5, p 875-877. 2 tab, 11 ref.

Descriptors: *Salmonella, Water pollution sources, *Recreation facilities, Runoff, Lakes, Beaches, Sampling, Bacteria, Tributaries, Streams, Bayou, Sewage, Wisconsin.
Identifiers: *Lake Mendota, Contamination, Washwater, Moore swab, Madison (Wisc).

In the summer and fall of 1968 various Salmonella serotypes were isolated from a portion of Lake Mendota, the major recreational lake for Madison, Wisconsin. The apparent sources of these organisms were a residential storm sewer and a University of Wisconsin Experimental Farms' washwater drain. Salmonellae were isolated with regularity from a swimming beach located approximately 0.5 mile from these sources. (Parker-Iowa State)

0445 - A2, F4

EFFLUENT DISPOSAL,
Lactose Co. of New Zealand Ltd., Kapuni.
J. M. Wood.
New Zealand Journal of Dairy Technology, Vol 4, No 4, December 1969, p 238-242.

Descriptors: *Dairy industry, *Waste disposal, *Water pollution sources, Legislation, Administration, Organic wastes, Biochemical oxygen demand, Milk, Oxidation, Water pollution control, Water pollution, Water temperature, Dissolved oxygen.
Identifiers: *New Zealand, Water Pollution Act, Effluent, Disposal.

An increasing concern in the preservation of natural water resources, and their protection from pollution is appearing in New Zealand even though the problem has not reached serious proportions there. This author has reviewed the New Zealand legislation with respect to this problem, especially the Water and Soil Conservation Act of 1967. He also reviews some aspects of river pollution and its causes and effects. He finishes with a brief discussion of some effluent treatment and disposal methods, with particular reference to the dairy industry. (Parker-Iowa State)

0446 - E1, F3

BASIC POINTS TO CONSIDER IN MANURE DISPOSAL PROBLEMS,
Richard D. Chumney.
Poultry Digest, December 1970, p 608.

Descriptors: *Farm wastes, *Pouitry, *Waste disposal, Regulation, Costs, Environmental effects, Technology.
Identifiers: Recycling.

The greatest deterrent to future progress of the U.S. poultry industry is the lack of technological and managerial know-how for proper and efficient disposal of poultry waste. In approaching the problem the following points should be considered: (1) Regulatory enforcement should not exceed the present 'state of the art.' (2) The cost of waste disposal must be included as a regular cost of doing business. (3) New techniques for the recycling of poultry waste into the soil and as feed supplements is the best long range approach. (4) Every precaution must be taken to protect our total environment as we dispose of poultry waste. (Parker-Iowa State)

0447 - F4

LIVESTOCK WASTES,
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
J. R. Miner.
Journal Water Pollution Control Federation, Vol 43, No 6, June 1971, p 991-998. 60 ref.

Descriptors: *Farm wastes, *Waste disposal, *Reviews, Waste treatment, Publications, Gases, Odors, Soil disposal fields, Aerobic treatment, Aeration, *Reviews, Bibliographies.
Identifiers: *Livestock wastes, *Literature review, Feedlot runoff.

This is a review of the literature on research in the area of livestock waste management and its influence on water quality. Discussions include waste treatment systems, waste characteristics, manure handling systems, gases and odors, application of wastes to cropland and cattle feedlot wastes. A short review of sixty references in this area is given. (Parker-Iowa State)

0448 - D4, E4

INDIAN UTILIZES NOVEL MANURE DISPOSAL SYSTEM,
Patel Poultry Farm, Boroda (India).
Jawahar D. Patel.
Poultry Digest, Vol 26, p 100-101, 1967.

Descriptors: *Farm wastes, *Methane, *Gases, *Anaerobic digestion, Fertilizers, Odor, Temperature, Disposal, Poultry, Fuels.
Identifiers: India, Working details.

An anaerobic digester that converts poultry manure into useful methane gas is being utilized in India. Poultry manure gives 1.5 to 2.0 cu. ft. of gas per pound in a short period of digestion and at a temperature of 35 degrees C. 35.3 cu. ft. of methane is equivalent to 2.2 kilowatt-hours of electrical energy. The digested manure is a valuable fertilizer because it supplies not only nutrients such as nitrogen, phosphorus, potash, iron, copper, cobalt, maganese, calcium, magnesium, etc., in a well-balanced proportion, but also most valuable humus to plants for successful crop production. (Christenbury-Iowa State)

0449 - F1, F4

WASTES FROM THE POULTRY INDUSTRY,
National Agricultural Advisory Service, Guildford (England).
C. T. Riley.
Agriculture, Vol 75, No 8, p 374-376, Aug 1968.

Descriptors: *Poultry, Reclamation, Waste disposal, Nitrogen, Fertilizer, Protein, Moisture.
Identifiers: *Refeeding wastes, Cage layers, Broilers, Deep litter, Recycling.

Some waste materials normally produced by the poultry industry are defined and their relative importance is indicated. The increasing volume of wastes produced and the economics of utilizing these poultry wastes are discussed. (Dorland-Iowa State)

0450 - A3, A4, C3

NITRATE AND SALT IN SOILS AND GROUND WATERS FROM LAND DISPOSAL OF DAIRY MANURE,
D. C. Adriano, P. F. Pratt, and S. E. Bishop.
Soil Science Society American Proceedings, Vol. 35, 1971. p. 759-762, 3 fig, 3 tab, 14 ref.

Descriptors: *Farm wastes, *Water pollution sources, Groundwater, Salinity, Leaching, Nitrogen, Ammonia, Irrigation, Pastures, Lagoon, Application rate.
Identifiers: *Dairy wastes, Chino-Corona Basin, Feedlots, Well waters.

The NO3 - contents of soils and ground waters underneath lands used for disposal of manures from dairies in the Chino-Corona Basin were determined. Soil and water samples were taken from 15 holes drilled to the top of water table in sites representing corrals, irrigated croplands, and pastures used as disposal areas. Considerable amounts of NO3- and salt were found in soil profiles underneath the disposal areas, although the magnitude was not as high as in profiles under corrals. Average NO3- -N concentrations in waters sampled from water tables were 26, 57, 45, and 74 ppm for control (undisturbed), corral, cropland, and pasture sites, respectively, exceeding the PHS recommended limit of 10 ppm NO3- -N for safe drinking water. Domestic well waters pumped from deeper aquifers averaged 6 ppm of NO- -N. Contributions of NO3- -N to ground waters, as indicated by deep soil samples, on a per unit area basis, tended to be: corralSpastureScropland. Existing conditions in the study area need some modifications if acceptable quality of the ground waters is to be maintained. (Bundy-Iowa State)

0451 - A9, C4, D4

REDUCTION OF SALMONELLA IN COMPOST IN A HOG-FATTENING FARM OXIDATION VAT,
E. H. Kampelmacher, and L. M. Jansen.
Journal Water Pollution Control Federation, Vol 43, No 7, July 1971, p 1541-1545. 4 fig, 3 tab, 3 ref.

Descriptors: *Farm wastes, *Oxidation ponds, Fertilizer, Swine, Aerobic, Aeration, Bacteria, Effluent, *Salmonella, Samples, Confinement pens, *Waste water treatment.
Identifiers: Oxidation vats, Bacteria count, Hog-fattening farm, Aerobic flora.

In recent years the number of large hog-fattening farms, where frequently thousands of animals are fattened, has increased greatly. On these farms, the disposal of urine and feces, which in such large quantities can no longer be used for fertilization, constitutes a serious problem. In order to deal with it by means of purification, oxidation vats have been constructed and oxidation ditches dug on these farms. A description is given of experiments carried out with a small experimental oxidation vat suitable for 160 hogs and installed on a hog-fattening farm in Wageningen by the Institute Landbouw en Bedrijfsgebouwen. The study was performed to determine whether bacteriological reduction in general and elimination of Salmonella in particular occur. The reduction of Salmonella in composts in an experimental oxidation vat on a hog-fattening farm was shown to be approximately 100-fold. As long as the excretion of Salmonella in the feces of the hogs remain low, only small numbers of Salmonella bacteria will be sluiced out with the effluent, thus, the possibility of human and/or animal infection in surface water may be regarded as very slight. As soon as either the number of hogs or the number of excreted bacteria, or both, increases, the plant can no longer adequately reduce the number of salmonellae to the extent that the effluent can be sluiced out into open water without the danger of human or animal infection. Therefore, it is recommended that adequate chlorination of the effluent of such plants be considered. (Bundy-Iowa State)

0452 - A4, C3

GROUNDWATER CONTAMINATION,
Guelph Univ. (Ontario). Dept. of Soil Science.
Robert W. Gillham, and L. R. Webber.
Water and Pollution Control, Vol 106, No 5, p 54-57, May 1968. 5 fig, 1 tab, 11 ref

Descriptors: *Groundwater, *Piezometry, *Water table, *Surface-groundwater relationships, *Water pollution sources, Infiltration, Wastes, Hydraulic conductivity, Subsurface drainage, Transmissivity, Head loss, Darcys law, Time lag, Nitrogen compounds, Nitrates, Discharge measurement, Discharge (Water), On-site data collections, Underflow.
Identifiers: *Hydraulic potential, Canada.

All inorganic salts of N are very soluble in water and N in the nitrate form is particularly hazardous for both humans and livestock. Barnyards and feedlots may be prime sources of inorganic N in groundwater. A piezometric network was installed radially throughout a barnyard for determination of groundwater discharge out of the barnyard so that it could be correlated with the changes in the N concentration of the water as it passed beneath the barnyard. The active head of water in a given piezometer was measured at different times. Its basic time lag, together with the geometry of the piezometer, could be used to calculate hydraulic conductivities from a large number of sites. These were then used to construct a map of isopotential lines indicating changes in hydraulic potential with distance. A simplifying assumption was that hydraulic potential did not vary vertically in the water table to bedrock. Together with N measurements at various depths to bedrock, the results showed that the barnyard contributed 0.00189 lb N/hr to the groundwater, or about 17.5 lb N/yr. This was considered surprisingly low, since the manure of a single cow could produce 74 lb N/yr. (Casey-Arizona)

0453 - A3, F3

PLANT NUTRIENTS AND WATER QUALITY,
C. R. Frink.
Agricultural Science Review, Vol 9, No 2, Second Quarter 1971, p 11-25. 4 tab, 3 fig, 34 ref.

Descriptors: *Cycling nutrients, Water quality control, Fertilizers, *Nutrients, Watersheds (Basins), *Farm wastes, Surface runoff, Subsurface runoff, Systems analysis, Farm wastes, Nitrogen, Nitrates, Agricultural chemicals, Fertilizers, Phosphorus, Water pollution sources.
Identifiers: *Plant nutrients, Political units, Farming systems.

Nutrient yields to waterways were examined in three ways: direct measurements in watersheds, analysis of farming systems, and calculations for political subdivisions. Direct measurements in watersheds have shown, for example, that agricultural runoff supplied significant quantities of nitrogen in the Potomac River Basin but was not an important source of phosphorus. Farming systems analysis was proposed to avoid the cost of a national water monitoring network. Such things as various methods of fertilizer application were considered. And the possibility of sewage effluent to a soil-crop filter rather than dilution in streams. The calculations of nutrient sources for political units should help us establish priorities in the expensive process of providing clean water. We ought to direct our efforts towards minimizing nutrient yields from all significant sources, and ask how much stopping the yields will cost society. The author suggests that we abandon our preoccupation with obtaining the maximum yield per acre and consider instead a system analysis of agricultural practices that will maximize all benefits to society. (Parker-Iowa State)

0454 - A1, F2, F3

SOCIAL ASPECTS OF ENVIRONMENTAL POLLUTION,
Oregon State Univ., Corvallis. Air Resources Center.
Robert M. Alexander.
Oregon Water Resources Research Institute, Corvallis, March 1971. 49 p, 31 ref. OWRR Project A-999-ORE (8).

Descriptors: *Social aspects, *Resource allocation, *Pollution abatement, *Industrial wastes, Environmental sanitation, Cost-benefit analysis, Marketing, Economics, Feasibility studies, Diseconomies of scale, Social values, Social change, Social needs, Pollutants, Water pollution, Air pollution, Pesticide toxicity, Radiation, Radioactivity effects, Waste disposal, Pollution abatement, Judicial decisions, Administrative agencies, Regulation, Permits.

The social aspects of environmental pollution resulting from scientific and technological changes in industry are examined. Specific side effects studied include air and water pollution, pesticide toxicity, and ionizing radiation. These are considered from several economic and political viewpoints. Social goals are broken down to determine the degree of pollution abatement possible in view of the costs involved. The extent to which society is willing to bear the cost of controlling industrial pollution, and who will bear these expenditures is analyzed. The article examines the market mechanism, side effects, and external costs, concentrating upon the market mechanism and its role in allocating resources. Alternatives are suggested for dealing with the side effects of pollution: (1) the establishment and protection of rights by private negotiation, (2) adversary proceedings, measures to strengthen judicial proceedings, and courts as a political force in fostering environmental quality; (3) regulation by licensing and permit issuance; and (4) incentive programs based upon payments or charges. The article concludes with a reassessment of key social issues in relation to a reordering of priorities so as to favor environmental quality. (Rees-Florida)

0455 - E1, F4

ANIMAL WASTE DISPOSAL BECOMES A MORE DIFFICULT PROBLEM,
Illinois Univ., Urbana. Dairy Science.
S. L. Spahr.
Illinois Research, Vol 12, No 4, p 4-5, Fall 1970.

Descriptors: *Disposal, *Odor, Farm wastes, Runoff, Illinois, Equipment, Farm lagoons, Gases, Water pollution control, Storage pits, Waste treatment.
Identifiers: Feedlot runoff, Oxidation ditch, Pollution potential, Uses, Research needs.

Many of the current systems of animal waste disposal may create serious health and pollution problems. Little knowledge is available to solve many of the problems facing the livestock producers. Current technology and future research needs for waste disposal are discussed. (Christenbury-Iowa State)

0456 - A5, B1

TRY TO KEEP ODORS UNDER CONTROL,
J. L. Skinner.
Poultry Digest, March 1971. p 116.

Descriptors: *Odor, Farm wastes, Poultry, Livestock, Management, Disposal, Public rights, *Waste treatment.
Identifiers: *Odor control, Public relations.

Four suggestions are given for managing conditions related to odor problems: (1) Reduce spillage and overflow from watering systems. (2) Make sure that manure removal systems actually remove manure and do not leave unnecessary accumulations in corners, adjacent to winch and drive mechanisms, and around discharge elevators. (3) Use only manure transport vehicles that do not spill or leak on roadways. (4) Avoid field spreading manure near residences, close to roads, late in the afternoon of still days or on weekends. (Hazen-Iowa)

0457 - B2, D4, E2

DISPOSAL OF LIQUID WASTES FROM PARLORS AND MILKHOUSES,
Pennsylvania Agricultural Experiment Station, University Park.
N. H. Wooding.
Special Circular 154 (1971), 12 p, 2 tab.

Descriptors: *Farm wastes, *Aerobic treatment, *Sprinkler irrigation, Solid wastes, Effluents, Treatment facilities, Lagoons, Milk, Irrigation systems, Permits, Pennsylvania, Legislation, Septic tanks, Liquid wastes, *Dairy industry, Cattle, *Waste water treatment, *Waste water disposal.
Identifiers: *Dairy cattle, Milking parlor wastes, Pennsylvania Clean Streams Law.

The problem of disposing of liquid wastes from dairy operations is becoming increasingly important in the light of current legislation. The Pennsylvania Clean Streams Law and its effect upon this disposal are discussed. The Clean Streams Law requires a waste water disposal permit for any facility that will discharge into surface or underground waters, create a danger of polluting these waters, or may be necessary for effective regulation of the facility even though it does not have a direct discharge. One of the major problems of a dairy operation is the disposal of milking parlor liquid wastes. One method of treatment is the use of aerobic lagoons, anaerobic lagoons being unacceptable due to the production of odors. Solid wastes and milk should be excluded to prevent overloading the system. The wastewater from the lagoon can be disposed of with a sprinkler-irrigation system. (Dorland-Iowa State)

0458 - D4, E2

USE OF SOIL TO TREAT ANAEROBIC LAGOON EFFLUENT: DESIGN AND OPERATION OF A FIELD DISPOSAL SYSTEM,
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
Dale H. Vanderholm, and Craig E. Beer.
Transactions of the American Society of Agricultural Engineers, Vol 13, No 5, p 562-564, Sept-Oct 1970. 1 tab, 2 fig, 17 ref. OWRR Project A-021-IA (3).

Descriptors: *Farm wastes, *Disposal, *Anaerobic digestion, *Irrigation systems, Runoff, Farm lagoon, Livestock, Pollutants, Biochemical oxygen demand, Chemical oxygen demand, Nitrogen, Odor, Storage capacity.
Identifiers: *Land requirements, Livestock wastes.

The study was initiated to investigate the pertinent variables involved and evaluate the performance of an irrigation system for the disposal of livestock waste. It was desired to determine irrigation rates, frequencies, and quantities that would result in satisfactory renovation of the lagoon effluent with no detrimental effects. The results indicate, that for waste-water irrigation, the tabulated rates for clear water are too high and should be reduced, possibly 30 to 50 percent. The average COD removal was 97 percent. Smaller applications made more frequently were the most efficient for COD reduction. 80 percent of the nitrogen is removed. 99 percent of the phosphates were removed. This method of waste disposal appears feasible. The results of the study indicate an optimum level for the observed soil and climatic conditions of about 2 in. of lagoon effluent per week during the growing season. (Christenbury-Iowa State)

0459 - B2, E2

LIQUID MANURE FOR MIDWEST SWINE PRODUCTION,
Illinois Univ., Urbana. Dept. of Agricultural Engineering. Liquid Manure for Midwest Swine Production,
D. G. Jedele.
Transactions of ASAE, Vol 2, No 1, 1959, p 9-10. 6 fig.

Descriptors: *Farm waste, *Swine, Septic tank, Sewage lagoons, Liquid waste, Irrigation, Confinement pens, Animal disease, Liquid wastes, Waste disposal.
Identifiers: *Tank wagon, *Spreaders, Storage tank, Material handling, Hand scraping.

With the trend of raising swine in confinement, renewed interest in liquid manure disposal is being created. The primary method used by Illinois swine producers is the collection of liquid manure in storage tanks, and then the disposal by tank wagon on crop land. The finishing floors are normally on slopes varying from 1/4 inch per foot to one inch per foot. The methods of cleaning floors range from hand scraping followed by water rinsing to high pressure water rinsing only. For hand scraping combined with rinsing about 1/4 gal. of water per hog is required. For high pressure rinsing about 1/2 gal. of water per hog is required. For computing capacities for storage tanks, a minimum of 2 gal. per hog per day is suggested. Up to this time most spreading equipment is homemade. The spreader used ranged from 6 ft. to 20 ft. spread per swath. (Bundy-Iowa State)

0460 - B3

EFFECT OF TYPE OF HOUSING AND LITTER ON PRODUCTION OF BROILERS,
Georgia Univ., Athens. Dept. of Poultry Science.
M. G. McCartney.

Poultry Science, Vol 50, No 4, p 1200-1202, July 1971. 2 tab, 8 ref.

Descriptors: *Air ventilation, *Consumptive use, *Efficiency, Disease, Chicken, Air contamination.
Identifiers: *Mortality, Enclosed housing, Open housing, White Plymouth Rock, Reused litter, Windowless type housing, Marck disease, Leukosis.

There has been considerable interest in the use of windowless-type houses for the production of broilers in the South. It is of general agreement that houses with fan ventilation are superior to the conventional house with respect to growth, feed conversion, mortality and condemnation of broilers to market age. The results of tests run to verify the hypothesis indicated that there were no real differences in the performance of broilers grown in open or enclosed housing or on new or old litter. Therefore, under the conditions of this study it is not possible to justify the cost of providing insulated, fan-ventilated housing for broilers. Also, since the type of litter did not affect condemnation, it is similarly not justified to recommend the use of new litter between successful lots of broilers from the standpoint of mortality or condemnations. (Bundy-Iowa State)

0461 - B3

FUMIGATION AND REUSE OF BROILER LITTER,
Hawaii Univ., Honolulu. Dept. of Animal Science.
E. Ross, and A. Y. Miyahara.
Poultry Science, Vol 50, No 4, p 1096-1100, July 1971. 4 tab, 12 ref

Descriptors: *Bacteria, Poultry, Disease, Feeds, Bactericide, Microorganisms.
Identifiers: *Methyl bromide, *Mortality rate, Reused litter, Coccidia, Concentration, Weight gain, Sterilized poultry litter, Broilers, Soil, Fumigant, Build up litter.

The scarcity of conventional litter material in some parts of the country is an increasing concern to broiler producers. The effect of methyl bromide fumigation of reused litter on chicken growth, feed conversion and mortality was investigated as a possible solution. To test these effects 6 trials on commercial broiler chicks were made. In 6 trials, commercial broiler chicks were reared on fresh wood shavings litter, reused wood shavings litter and reused wood shavings litter that had been fumigant with 1-10 kg. of methyl bromide/20.5 m.2 of litter. Increasing levels of fumigant reduced the bacterial count in the litter without achieving sterilization and without otherwise affecting weight gains, feed conversion or mortality. (Bundy-Iowa State)

0462 - C1, C5

NUTRIENT DIGESTIBILITY USING FECAL COLLECTION APPARATUS AND INDICATOR METHOD FOR STEERS FED AD LIBITUM,
Kentucky Univ., Lexington.
P. A. Phar, N. W. Bradley, C. O. Little, L. V. Cundiff, and J. A. Boling.
Journal of Animal Science, Vol 33, No 3, p 695-697, September 1971. 4 tab, 12 ref.

Descriptors: *Digestion, *Nutrients, Analytical techniques, Animal waste, Confinement pens, Cattle.
Identifiers: *Chromic oxide indicator, *Fecal collection apparatus, Pelleted ration, Ad libitum, Feed trial, Crude protein, Crude fiber, Ether extract, Gross energy coefficient, Steer.

Six 2-year-old steers weighing an average of 453 kg were randomly assigned to a cross-over design to study the effects of fecal collection apparatus on the apparent digestibility of nutrients when a complete, pelleted ration was fed ad libitum and to compare total collection versus chromic oxide indicator coefficients. Chromic oxide was mixed with the ration prior to pelleting at the rate of 0.5%. Fecal samples were taken twice during a 24-hr. period and composited at the end of the 6-day collection period for each steer. Sampling times representing each 2-hr. interval were randomly assigned to days. Average daily feed intake was not significantly affected by fecal collection apparatus. There was no significant difference in crude protein, crude fiber, ether extract, N.F.E. or gross energy coefficients calculated by the conventional and indicator methods; however, there was a significantly (PA.01) lower dry matter coefficient when calculated by indicator method. When the indicator method of estimating digestibility was used to compare the effect of collection apparatus versus no apparatus on digestibility of nutrients, the N.F.E. digestibility was significantly (PA.05) lower in the steers without the fecal collection apparatus. Coefficients of digestibility for dry matter, crude protein, crude fiber, ether extract and gross energy were not significantly (PS.05) affected by fecal collection apparatus. (Bundy-Iowa State)

0463 - C3, E3

CHEMICAL COMPOSITION OF POULTRY MANURE.

Poultry Digest, p 439-441, September 1971. 4 tab.

Descriptors: *Chemical waste, *Crop response, Essential nutrients, Chemical analysis, Poultry, Organic acids, Rates of application, Nutrients.
Identifiers: *Broiler houses, *Micronutrients, *Laying house, Wasted feed.

The value of poultry manure as a crop fertilizer has been measured primarily in terms of nitrogen, phosphorus, and potassium. Very little consideration has been given to the micronutrients content. There are substantial amounts of calcium, magnesium, and sulfur. The micronutrients includes manganeso, iron, boron, copper, zinc, and molybdenum. The mean calcium and magnesium contents of broiler manure were 1.97 and 0.37%, respectively, which were less than for hen manure with calcium content of 3.42% and magnesium of 0.52%. With present knowledge of the requirements of most crop plants for micronutrients indicates that, except in cases of extreme deficiency, application of three to five tons per acre of broiler or hen manure annually would maintain and adequate supply of these elements. (Bundy-Iowa State)

0464 - C1

EXTRACTION OF BILE ACIDS FROM RAT FECES CONTAINING CHOLESTYRAMINE,
Mead Johnson Research Center, Evansville, Ind. Dept. of Nutritional Research.
J. D. Manes, and D. L. Schneider.
Journal of Lipid Research, Vol 12, No 3, p 376-377, 1971.

Descriptors: *Gas chromatography, *Rodents, Chemical analysis, Laboratory animals, Laboratory tests, Methodology, Test procedures, Analytic techniques.
Identifiers: *Bile acids, Gas-liquid chromatography, OV-21.

The fecal extraction procedure described by Evrard and Janssen was inadequate for the complete extraction of conjugated bile acids from feces containing the bile acid sequestrant, cholestyramine. As judged by gas-liquid chromatographic analysis, substitution of 0.5 n HCl in absolute ethanol for glacial acetic acid allowed for complete recovery (98-104%) of three different conjugated bile salts in the presence of the resin. (Parker-Iowa State)

0465 - A1, C3, C5

FEED ADDITIVE RESIDUES IN POULTRY MANURE,
Agricultural Research Service, Beltsville, Md.
C. C. Calvert.
Poultry Digest, August 1971, p 396-398.

Descriptors: *Poultry, *Feeds, *Additives, Arsenic compounds, Animal diseases, Farm wastes, Antibiotics, Environmental effects.
Identifiers: *Feed additives, Residues, Growth stimulants.

At this stage, very little is known as to the potential hazard to the environment represented by commonly used feed additives. The amount of residues excreted and the composition of that residue of such additives as antibiotics, arsenicals, nitrofurans and others are discussed. Studies are cited giving the present state of knowledge on these residues and their pollutional effects on the environment. (Parker-Iowa State)

0466 - A4, C4

INFILTRATION RATES AND GROUNDWATER QUALITY BENEATH CATTLE FEEDLOTS, TEXAS HIGH PLAINS,
Texas Tech Univ., Lubbock. Dept. of Geoscience.
William D. Miller.
Environmental Protection Agency-Water Quality Office, Water Pollution Control Research Series Report, January 1971. 55 p, 26 fig, 11 tab, 6 ref. EPA Program 16060 EGS 01/71.

Descriptors: *Nitrates, *Groundwater, Water quality, *Infiltration, Soils, Drainage, Seepage, Runoff, Water pollution sources, Path of pollutants, Water analysis.
Identifiers: *Ogallala formation, *Core chemistry, Permeability, *Texas High Plains, Geologic environment, *Feedlot runoff.

Detailed field and laboratory studies of five feedlots were conducted to determine field seepage rates and distributive geometry of infiltrated runoff. Practical field seepage rates at these sites ranged from 2 to 20 feet/year. Dispersal rates of ions in the groundwater zone varied from 45 to 400 feet/year. Nitrogen (NO3, NO2, NH4, Org-N) and common chemical parameters (Ca, Mg, Na, K, Cl, SO4, TDS, pH, and conductance) were determined in cores and groundwater samples; based on groundwater analyses from 80 Texas High Plains feedlots, rates of concentration of NO3-N and Cl in groundwater beneath feedlots range from 0.07 to 0.4 p.p.m. per year, and average 0.17 p.p.m. per year. Laboratory determined constant head vertical permeability of cores from 22 feedlot sites revealed a range in values of .01 to .000001 cm/sec for Ogallala sediments, .0001 to 10 to the minus 7th power cm/sec for near-surface material of floodplains and feedpen-runoff surfaces, and values of .000001 to 10 to the minus 8th power cm/sec for playa clay. Factors related to runoff-infiltration were correlated with groundwater quality, and it was determined that local surficial material and regional soils patterns are closely related to quality of groundwater beneath feedlots. Direct correlation of water quality does not exist with feedpen-runoff slope, cattle load, and surface-area ratios of drainage basin to collection system.

0467 - A5, C3

IDENTIFICATION OF FEEDLOT ODORS,
California Univ., Riverside. Statewide Air Pollution Research Center.
J. Fosnaugh, and E. R. Stephens.
Statewide Air Pollution Research Center (final report), Grant No U100531-02, p 1-24, April 30, 1969. 3 fig, 2 ref.

Descriptors: *Chromatography, Ionization, Laboratory tests, *Odors, Chemical analysis, *Farm waste, Organic compounds, Cattle, *Pollutant identification.

Identifiers: *Feedlot odors, Field analyzing technique, Ambient concentration, Ionization detector, Trimethylamine, Amines.

The proximity of cattle feedlots to suburban housing has created local air pollution problems which in some instances have forced feedlots to cease operation or to move. The principal objective of this project was to identify the odorant compounds and to develop methods for their detection and measurement. Several pieces of evidence point to the light weight amines as the principal offenders. In particular, trimethylamine has an odor threshold below 1 ppb and can be detected in feedlot air at concentrations above this. Other amines, ammonia, and perhaps other compounds may also contribute to the odor. Of the several analytical methods tested gas chromatography and paper chromatography showed the most promise. Neither was developed into routine use. (Bundy-Iowa State)

0468 - A6, B1

EFFECT OF VENTILATION ON THE GAS CONCENTRATION IN A PART-SLATTED PIGGERY,
North of Scotland Coll. of Agriculture, Aberdeen. Scottish Farm Buildings Investigation Unit.
A. M. Robertson, and H. Galbraith.
Farm Building Research and Development Studies, May 1971. 9 fig, 3 tab, 21 ref.

Descriptors: *Gases, *Hogs, *Ventilation, Effects, *Carbon dioxide, *Ammonia, *Hydrogen sulfide, Air circulation, Waste storage, Storage tanks, Environmental effects, Temperature, Toxicity, Animal physiology.
Identifiers: *Gas concentration, Slotted floor, Manure, Swine.

The concentrations of carbon dioxide, ammonia, oxygen, and hydrogen sulfide were recorded over the dung channel of a slatted floored house for growing/finishing pigs. Data was collected at ventilation rates varying from 0.262 m cu/h kg to 1.234 m cu/h kg live weight and during emptying of the channel. At summer ventilation rates concentrations of 7.6 ppm H2S, 9.1 ppm NH3 and 600 ppm CO2 were recorded. Concentration of toxic gases increased with volume of manure in the channel and depended on the ventilation rate. At winter rates concentrations in excess of 20 ppm H2S were recorded. (Parker-Iowa State)

0469 - A5, C3

WHY DOES IT SMELL SO BAD,
Wisconsin Univ., Madison. Dept. of Agricultural Engineering.
Clyde L. Barth.
Paper presented at the 1970 Annual Meeting American Society of Agricultural Engineers, ASAE 70-416. 22 p, 5 fig, 1 tab, 65 ref.

Descriptors: *Odor, Farm wastes, Pollutants, Strength, Temperature, Instrumentation, Measurement.
Identifiers: *Smell, Olfactory mechanism, Perception, Theories, Literature, Odor quality, Stimuli.

Researchers must learn more about manure odor production and control. Many unanswered problems face the farmer now. A review of pertinent literature clarifies the present status of the knowledge of odor perception, and creates an awareness of the pitfalls to be avoided in planning, conducting and analyzing odor related research. (Christenbury-Iowa State)

0470 - A5, D2

CONTROLLING ODORS FROM CATTLE FEED LOTS AND MANURE DEHYDRATION OPERATIONS,
Memphis Cattle Feeders, Inc., Millington, Tenn.
Robert Moorman, Jr.
Air Pollution Control Association Journal, Vol 15, 1965, p 34-35.

Descriptors: *Farm wastes, *Odors, Legal aspects, Dehydration, Spraying, Disposal, Management.
Identifiers: *Feedlots, Public relations.

This paper discusses various methods of odor control for cattle feed lots. The human and physical conditions that exist which allow and cause odor problems to arise and become a community source of trouble are discussed. These include a negative attitude and a lack of understanding on the part of the parties concerned. The odor problems can be alleviated through cooperation and sincere effort. The use of dehydration units have been only partially successful. Public relations between feed lot and the community are very important. (Christenbury-Iowa State)

0471 - B1, D2

ACCELERATION OF NATURAL DRYING OF POULTRY MANURE THROUGH MECHANICAL AGITATION,
California Univ., Davis.
James A. Moore, and Samuel A. Hart.
Unpublished paper. Presented Pacific Coast Region American Society of Agricultural Engineers, 1968. Paper No PC 68-121. 2 fig, 2 ref.

Descriptors: *Farm wastes, *Sublimation, Drying, Moisture content, Till, Winter, Freeze drying, Freezing, Equipment.
Identifiers: Relative humidity, Tiller drying, Natural drying.

Wet manure rather quickly becomes objectionally odorous. One solution to the manure problem would be an economical and efficient means of reducing the moisture content. The concept of sublimation was evaluated as a means of natural drying of poultry manure. The use of a mechanical agitator was incorporated into the system. The drying phenomenon that allows clothes to dry in winter weather would not work with manure. The tiller-drying to accelerate natural drying of manure in summer was very effective. (Christenbury-Iowa State)

0472 - A5, B2, C1

A YEAR IN THE LIFE OF A SLURRY COMPOUND,
J. M. Kindell.
Agriculture, Vol 78, No 6, p 268-269, June 1971.

Descriptors: *Farm waste, Cattle, Surface runoff, Slope, Economic feasibility, Waste storage, Storage capacity, Porosity, Odor, Waste disposal.
Identifiers: *Dairy cattle, Slurry compound, Slurry disposal, Feed ration.

To eliminate the difficulty of spreading the slurry compound from a dairy farm in northern Chilterns, a storage tank to hold the full winter's storage of slurry was built. The system was built for an operation of sixty Friesian milkers. The storage area, 90 ft. long and 66 ft. wide, was excavated to an average depth of 2 ft. which produced sufficient flinty clay material to form the side and end walls. The excavated clay was used to built a bank around the area which would hold the slurry to a depth of about 3 to 4 ft. The disposal system was reasonably cheap to install, operate, and maintain and it avoided the daily or weekly chore of manure disposal in the winter. No smell, fly or other nuisance arose during the period of storage in the compound. On emptying, the smell, although powerful, was of limited duration. The amount of percolation into the subsoil appeared to be negligible on account of the clay-based subsoil forming the floor of the compound. In calculating the storage capacity of the slurry compound, it seems prudent to be on the generous side. Half a cubic yard per cow per week for the winter housing period is a useful guide. (Bundy-Iowa State)

0473 - F5

BOD OF CAPTIVE WILD ANIMAL WASTES,
Tulane Univ., New Orleans, La. Dept. of Civil Engineering.
F. W. Macdonald, and H. R. Davis.
Water and Sewage Works, Vol 113, February 1966, p 64-67. 2 tab, 2 ref.

Descriptors: *Biochemical oxygen demand, Animals, Animal wastes (Wildlife).
Identifiers: *Wild animals, *Zoo, Total solids, Captive animals, Primates.

The findings of an analysis of the animal waste from a zoo are reported. The total solids and the BOD per pound of animal are reported. The results of this study may well serve as a guide in the design of plants for the disposal of wild animal wastes. (Christenbury-Iowa State)

0474 - B1, C2, C3, C5

PROPERTIES AND PUMPING CHARACTERISTICS OF HOG WASTES,
E. P. Taiganides, T. E. Hazen, E. R. Baumann, and H. P. Johnson.
Transactions of the American Society of Agricultural Engineers, Vol 7, p 123-124, 127, 129, 1964. 3 fig, 1 tab.

Descriptors: *Farm wastes, *Hogs, Properties, *Pump testing, Solid wastes, Performance, Pumping, Efficiencies, Biochemical oxygen demand, Waste identification.
Identifiers: *Waste properties, *Characteristics, Volatile solids.

Hog wastes from a confinement hog production unit were analyzed for daily quantity and physical and chemical properties. The pumping characteristics of the untreated hog wastes were determined with a diaphragm pump and a 6-inch auger. The quantity and quality of the manure are affected primarily by the size of the hogs, the type and quantity of the feed intake, the quantity of the water intake and the air temperature. The daily quantity of manure removed varies with the time of year. The average total solids content of the manure was 18.5 percent and 15.6 percent during the hot and cold months of the year respectively. The total nitrogen of the manure was 7 percent of the total dry matter. Results of the auger pumping test showed that manure can be pumped with greater efficiency and less power consumption than water. With the diaphragm pump the maximum pumping capacity for water is obtained at a higher pump speed than for manure under similar conditions of operation. The results of the pumping tests were presented graphically. (Parker-Iowa State)

0475 - E3

LIQUID DIGESTED SEWAGE SLUDGE GIVES FIELD CROPS NECESSARY NUTRIENTS,
O. C. Braids, M. Sobhan-Ardakani, and J. A. E. Molina.
Illinois Research, Vol 12, No 3, Summer 1970, p 6-7. 3 tab, 1 fig.

Descriptors: Sludge, Sludge disposal, *Sewage sludge, *Nutrients, Nitrates, Analysis, *Field crops, Crop production, Soil analysis, Leaching, Corn, Sorghum, Lysimeters.
Identifiers: Digested sludge, Heavy metals, Reed canary grass, Drain water.

Irrigation of cropland with digested sludge is seen as a way of recycling the elements and reducing ultimate disposal costs. To learn more about this subject, a study utilizing an existing lysimeter facility was conducted. A digested sludge having a solids content of 2 to 4 percent by weight was obtained from a sewage treatment plant. A 1-inch application of sludge on an acre contains about 330 pounds of nitrogen, 180 pounds of phosphorus and 40 pounds of potassium. Corn, Reed canary grass, and grain sorghums were grown with two levels of sludge irrigation; 10 inches in 1968 and 7 inches in 1969. This level, without exception, produced yields as good as, or better than, those obtained with water irrigation and relatively high levels of commercial fertilizer. In this test crop and leaf analysis were made as well as soil analysis. The drain water was also analyzed. One problem noted was the increased concentration of nitrate-nitrogen found in the water from the sludge-treated plots. The nitrogen content of digested sludge appears to be the first limiting factor to loading rate. (Parker-Iowa State)

0476 - C4

THE MICROFLORA OF SOUTHERN OHIO POULTRY LITTER,

J. Lovett, J. W. Messer, and B. Read, Jr.
Poultry Science, Vol 50, No 3, May 1971, p 746-751. 7 tab, 17 ref.

Descriptors: *Farm wastes, *Poultry, *Microorganisms, Ohio, Chemical analysis, Analytical techniques, Salmonella, Cultures, Coliforms, E. coli, Molds, Fungi, Plants, *Waste identification.
Identifiers: *Microflora, Total count, Poultry litter.

Poultry litter from four Southern Ohio farms was analyzed; the microflora was enumerated, and the fungal population was classified to genera. At each farm, litter was taken from several areas within the poultry house. Composite litter samples were ground in a Wiley mill. Three media and two incubation methods were evaluated before deciding on the total count procedure. TSA consistently yielded greater counts than either PCA or STCM. Litter pH and total bacterial and fungal counts increased with litter usage to about one month, then declined slightly and remained constant thereafter. Coliform and Escherichia coli were constant throughout the sampling period for all litter. After one week of litter use, approximately 10 per cent of the total microbial population was found to consist of coliform. Twelve fungal genera were identified from poultry feeds. A wider variety of mold genera was isolated from litter. (Parker-Iowa State)

0477 - C4, D4, E4

BIOLOGICAL CONVERSION OF ANIMAL WASTES TO NUTRIENTS,

Colorado State Univ., Fort Collins. Dept. of Avian Science.
B. F. Miller.
Final report, May 1971. 69 p, 9 fig, 10 tab, 36 ref, append. Project no. HGW-PHS Solid Wastes Research Grant EC-00262-02.

Descriptors: *Farm wastes, *Lagoons, *Chemical analysis, Crop response, Anaerobic bacteria, Odor, Amino acid, Poultry, Cattle, Larvae, Incubation, Organic matter, Soil structure, Economics, Nutrients.
Identifiers: *Feed analysis, Automated manure handling, Caged laying, Crop yield, Plant nutrients.

Fly eggs were placed in fresh poultry manure under different temperature (22 to 38C) and relative humidity (19 to 80%) conditions to determine the hatchability of fly eggs, growth of larvae, production of pupae and physical changes in the poultry manure. Moisture loss from the manure was recorded daily. The inoculation rates varied from 2 g. to 5 g. fly eggs per 4000 g. of fresh poultry manure. Fly eggs and larvae were also placed under caged laying hens for the catabolism of the manure as it was voided. Optimum yield of dry pupae was obtained with a combination of 3 g. fly eggs in 4000 g. of fresh poultry manure at 27C and relative humidity of 41%. Moisture in the manure was reduced from 78.5 to 55.0%. When relative humidity was increased from 38 to 70% the yield of pupae at 34 to 38C was significantly (PA0.01) increased. The combination of 2 g. eggs per 4000 g. of fresh manure produced significantly (PA0.01) heavier larvae. Hatchability of fly eggs in fresh poultry manure varied from 50.5 to 87.0%. In comparison to fresh poultry manure, the manure residue had less odor, contained less moisture and was granular in texture. The fly larvae developed well under the caged layers, reducing freshly voided manure to granular material within a few hours. (Bundy-Iowa State)

0478 - D4

LABORATORY STUDIES OF AEROBIC STABILIZATION OF SWINE WASTE,

Minnesota Dept. of Health, Glenwood; Illinois Univ., Urbana. Dept. of Agricultural Engineering.
R. L. Irgens, and D. L. Day.
Journal of Agricultural Engineering Research Vol 11, No 1, p 1-10, 1966. 6 fig, 7 tab, 11 ref.

Descriptors: *Farmwastes, *Swine, Aerobic treatment, Waste disposal, Chlorination, Waste treatment, Oxygenation, Oxidation lagoons.
Identifiers: Aerobic stabilization, Swine waste treatment, Aeration of wastes.

Pig waste was allowed to accumulate in a pit beneath a slattered floor swine finishing building for one week or one month. Samples of this waste were brought to the laboratory for analysis and aerobic stabilization. It was concluded that adding raw waste continuously to the aeration unit gave the best results. The treated effluent had a BOD of 10 to 15 p.p.m. and contained only a trace of ammonia. Treatment by the aerobic process made the swine waste virtually odorless and stable. About 6 ft. 3 of liquid was required to dilute the waste from 150 lb. pig at the beginning of the aerobic process and 2500 ft. 3 of air was needed per pound of BOD. However, the more efficient oxygenation obtained with an aeration rotor in an oxidation ditch might reduce the latter value considerably. It was estimated that 36 KWh might be required per pig per year for operation of the aeration rotor of an oxidation ditch chlorination of diluted swine waste eliminated a certain degree of odor and improved flocculation and dewatering of the solids. The COD of the chlorinated and filtered waste was reduced 72%. Chlorinated compounds of various types may have similar effects. (Hazen-Iowa State)

0479 - A6, B1

THE INFLUENCE OF GRADED LEVELS OF ATMOSPHERIC AMMONIA ON CHICKENS,

Nottingham Univ. (England). School of Agriculture.
D. R. Charles, and C. G. Payne.
British Poultry Science, Vol 7, p 177-187, 189-198, 1966. 16 tab, 32 ref.

Descriptors: *Farm wastes, *Environmental effects, *Air pollution, *Air pollution effects, Growth, Rates, Respiration, Performance, Productivity, Ventilation, Air circulation, Poultry , Ammonia, Eggs.
Identifiers: *Ammonia toxicity, *Food consumption, Ammonia concentrations, Respiration rates, Food conversion efficiency.

A detailed description is given of studies done on the effects of air pollution on white leghorn chickens. The studies were done in two parts, one on broilers and replacement chickens and the second on laying hens. One hundred parts per million by volume of ammonia caused reductions in the respiration rates of adult hens between 7 and 24 percent. Broiler chickens from 28 days of age tended to eat less food than those reared in ammonia free atmospheres. At 100 p.p.m. of ammonia their growth rate was significantly reduced. Replacement laying pullets raised in ammonia containing atmospheres from 11-18 weeks of age had reduced food intake than those in ammonia free atmospheres. Pullets raised in atmospheres with high ammonia concentrations matured up to two weeks later than those in atmospheres free of ammonia. Atmospheres of 105 p.p.m. of ammonia significantly reduced egg production after 10 weeks exposure. No effects were observed on egg quality. Voluntary food intake was reduced and live-weight gain was lower in ammoniated atmospheres. High protein, vitamin, and mineral diet prevented the onset of any deleterious effects of ammonia on egg production, even though food consumption fell to 75 g./bird/day at 29 C., 43% humidity and 104 p.p.m. of ammonia when a low energy diet was fed to hens in high ammoniated atmospheres. Their production deteriorated rapidly. (Hazen-Iowa State)

0480 - C1, F5

CAGE AND KENNEL WASTE WATER,

National Institutes of Health, Bethesda, Md. Div of Research Services.
N. A. Jaworski, and J. L. S. Hickey.
This was reported as 'NIH Detergent for Mechanical Washing of Laboratory Glassware and Animal Cages' Sanitary Engineering Branch Project 136 (1955). Journal Water Pollution Control Federation, Vol 34, No 1, p. 40-43, Jan, 1962. 1 fig, 5 tab, 2 ref.

Descriptors: *Waste water disposal, *Biochemical oxygen demand, Waste water, Water analysis, Animal wastes (Wildlife), Waste identification, Waste dilution, Waste water treatment, Laboratory animals.
Identifiers: *Waste water production, Total solids, Volatile solids, Composite samples, Cage cleaning wastes, Kennel

The National Institutes of Health is planning a laboratory-animal colony in an unsewered area. The waste water from the colony will require treatment on the site. The waste water from cage cleaning and kennel cleaning is expected to represent a large percentage of the total sewage of the colony. A study of the volume and character of the waste water of a similar animal colony to the one porposed was made. Mechanical washers are used to clean the cages. Each washer contains a 1,000-gallon recirculating wash water tank and a 500-gallon, recirculating, rinse water tank. Excess water overflows to the sewers. Samples of the overflow were collected at 30-minute intervals. These samples were composited in proportion to the quantity of waste water from each machine. The BOD IN THE OVERFLOW WAS LESS THAN THAT IN THE WASTE WATER DRAINED FROM THE TANKS. The PH was 11.0 and the temperature was 140 to 160F of the waste water. The BOD, total solids, and volatile solids of the waste water from hosing of the pens was approximately three times per unit volume as that found in domestic sewage. The waste water has a sharp, unpleasnat odor, which might constitute a problem when it is treated in a population area. (Hazen-Iowa State)

0481 - E2, E3, F5

RETURNING WASTES TO THE LAND, A NEW ROLE FOR AGRICULTURE,

Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.
Herman Bouwer.
Journal of Soil and Water Conservation, Vol 23, 1968, p. 164-168, 2 fig, 1 tab, 22 ref.

Descriptors: *Irrigation, *Water reuse, *Waste disposal, Sewage effluents, Water quality control.
Identifiers: *Waste water renovation, Land disposal.

This article discusses the use of land or soil to dispose of and treat domestic, industrial, and agricultural sewage and wastes. Several projects are mentioned where this is being done on an experimental or trial basis. The major objectives may be sludge removal, groundwater renewal, irrigation or a combination of the three. The soil purifies the waste. Nutrients are also supplied to plants if the amount of effluent applied is not excessive. The economics of land disposal is also discussed. A more detailed description is given of the Flushing Meadows Project near Phoenix, Arizona. (Parker-ISU)

0482 - A2, A4, C5

THE EFFECT OF FARM WASTES ON THE POLLUTION OF NATURAL WATERS,

Wisconsin Univ., Madison; and Marathon County Center, Wausau, Wis.
S. A. Witzel, N. E. Minshall, E. McCoy, R. J. Olsen, and K. T. Crabtree.
Paper No. 69-428 presented at the 1969 Annual Meeting, American Society of Agricultural Engineers at Purdue University, W. Lafayette, Indiana. June 22-25, 1969. 24 p, 2 fig, 4 tab, 14 ref. Project No. OWRR B-004-WIS (12).

Descriptors: *Farm wastes, *Groundwater, *Nutrients, *Water pollution, Nitrates, Nitrites, Potassium, Phosphorus, Wells, Supplemental irrigation, Fertilizers, Fishkill, Eutrophication.
Identifiers: *Groundwater pollution, Well contamination, Algal growth, Deoxygenation.

Natural surface waters are subject to enrichment with the plant nutrients N, P, and K, and subsurface waters are often subject to pollution with nitrate and nitrite nitrogen. A study was begun in 1963 to determine the sources and amounts of plant nutrient losses from agricultural operations and to locate any health hazards that may result from the disposal of farm animal wastes. Nutrient losses in the base flow of southwestern Wisconsin streams during the period of high winter runoff totaled only 25% as much N and K and 10% as much P as in the surface runoff. Heavy manure applications in the vicinity of farm buildings or large feedlot operations can result in dangerously high nitrate concentrations in farm wells. Heavy supplemental irrigation combined with heavy nitrogen fertilizer application may result in an increase in the nitrates in ground water. Heavy annual applications of manure and/or fertilizer to large land masses which allow more than 13.5 lb. per acre of nitrogen to pass beyond the root zone could raise the groundwater to the toxic level of nitrates, assuming that all the nitrogen reaches the groundwater and that the aquifer is static. (Dorland-Iowa State)

0483 - B1, F4

HOW CAN PORK PRODUCERS COMPLY WITH ENVIRONMENTAL QUALITY STANDARDS,

Iowa State Univ., Ames. Dept. of Agricultural Engineering.
J. Ronald Miner.
American Pork Congress-Proceedings, Environmental Quality Workshop, Des Moines, Iowa, Mar 3, 1971. p 98-102.

Descriptors: *Farm wastes, *Hogs, *Environment, *Pollution abatement, Water quality, Standards, Water pollution, Air pollution, Odor, Confinement pens, Organic matter, Nutrients, Nitrogen, Phosphorus, Eutrophication, Algae, Pathogenic bacteria, Effluent, Irrigation, Storage, Waste disposal.
Identifiers: *Environmental quality, Air contaminant, Stream quality, Waste management, Manure collection, Manure transport.

To prevent water and air pollution while maintaining environmental quality is a complex problem. It becomes more complicated by trying to design waste management systems which contribute materially to our effectiveness as pork producers with pollution control as a side benefit. A swine manure management system might include a collection device, a manure transport system, some means of manure storage and/or treatment, and finally, a manure or effluent disposal system. In some cases more than one of these components may be included in a single component. Giving initial consideration to the disposal scheme will help determine decisions to be made concerning the other aspects of the system. There is much remaining to be learned relative to the control and measurement of odors. Various odor levels can be achieved by the judicious selection of manure handling techniques. (White-Iowa State)

0484 - A3, C4

RELATIONSHIPS OF SALMONELLAE TO FECAL COLIFORMS IN BOTTOM SEDIMENTS,

Environmental Protection Agency, Cincinnati, Ohio. Div. of Water Hygiene.
D. J. VanDonsel, and E. E. Geldreich.
Water Research, Vol 5, No 11, p 1079-1087, November 1971. 3 fig, 3 tab, 21 ref.

Descriptors: *Indicators, *Salmonella, *Sediment-water interfaces; Coliforms, Sampling, Mud-water interfaces, Water quality, Sediments, Pathogenic bacteria, Streptococcus, Domestic wastes, Farm wastes, E. coli, *Bottom sediments.
Identifiers: *Bottom sampler, Resuspension, Bacterial concentration.

The use of bottom sampling in water quality investigations is presently limited; however, the mud may serve as a concentrated and stable index of the quality of the overlying water. Salmonellae can be isolated from bottom sediments with far greater frequency than directly from the overlying water. Salmonellae were isolated from 19 percent of the mud samples when fecal coliform density in the overlying water was between 1 and 200 per 100 ml; from 50 percent between 201 and 2000; and from 80 percent over 2000. Fecal coliform to fecal streptococcus ratios of the overlying waters indicated that most of the isolated salmonellae originated in domestic sewage, but there were some positive samples with low ratios, which suggests that their salmonellae came from livestock or wildlife. Mud-water interfaces are not static systems, sludge banks can shift to a new position in response to currents, storms, and dredging operations. The consequent recirculation of older pollutants poses new problems in water quality which must be considered. (Dorland-Iowa State)

0485 - E3, F2

POULTRY LITTER AS CATTLE FEED,

Missouri Univ., Columbia. Dept. of Animal Husbandry.
Melvin Bradley, and Walter Russell.
Feedstuffs, Vol 37, No 8, p 59-60, February 20, 1965.

Descriptors: Farm wastes, Legal aspects, Feeds, Missouri, Poultry, Hazards, Efficiencies.
Identifiers: Broiler litter, Bloat, Rate of gain.

This article reviews the literature on feeding of poultry litter to beef cattle, discussing hazards and legal implications and giving recommendations if litter is used as a feed. Research is reviewed from Texas, Arkansas, Georgia and Virginia. (Christenbury-Iowa State)

0486 - B1

FARM ANIMAL-WASTE MANAGEMENT.

Iowa State Univ., Ames. Dept. of Agricultural Engineering.

Miner, J Ronald (Ed). North Central Regional Publication 206, Special Report 67, May 1971. 44 p, 34 tab, 85 ref.

Descriptors: *Farm wastes, *Disposal, Waste water treatment, *Management, Hydroponics, Incineration, Pollutants, Diseases, Design criteria, Anaerobic digestion, Aerobic treatment, Aerobic bacteria, Zoonoses, Anaerobic bacteria, Farm lagoons, Chemical properties, Physical properties, Pathogenic bacteria, Environmental effects.
Identifiers: Composting, Oxidation ditches, Ruminant digestion, Nonruminant digestion, Disease transmission, Feedlot-runoff.

Current practices, technology, knowledge, and research results are summarized as related to the management and disposal or use of farm animal wastes in the 13 states of the North Central Region and other cooperating states. Among alternative systems of management and treatments described, attention is given to relative effectiveness in eliminating or minimizing detrimental environmental and ecological consequences. Detailed information is included on the biology and biochemistry of waste treatments; characteristics of animal wastes, including biological, physical, and chemical properties; aerobic, anaerobic, and combined treatments of animal wastes; composting, incineration, dehydration, and hydroponics; and actual and potential productive utilization of animal wastes. Needs for additional research are suggested. (Christenbury-Iowa State)

0487 - A3, D4

NITRATE REMOVAL FROM AGRICULTURAL WASTE WATER,

Federal Water Pollution Control Administration, Fresno, Calif.; and California Dept. of Water Resources, Fresno.
Percy P. St. Amant, and Louis A. Beck.
In: Water Quality Management Problems in Arid Regions, Water Pollution Control Research Series, 13030 DYY, 6/69, Oct 1970, USDI, Federal Water Quality Administration, p 1-8. 1 tab, 1 fig.

Descriptors: *Return flow, *Nitrates, Water pollution, Desalination, Algae, Denitrification, California, Filters, Particle size, Anaerobic conditions, Waste water treatment.
Identifiers: *Nitrate removal, Algae stripping, Pond denitrification, Filter denitrification, Methanol, Bacterial denitrification, San Joaquin Valley.

The problem of disposing of irrigation waste water from the San Joaquin Valley of California is a very large one. The most serious potential pollutant is nitrogen in the nitrate form. A waste water treatment center at Firebaugh, California has organized and is carrying out research in the areas of desalination, algae stripping, and bacterial denitrification. Algae stripping simply involves growing a crop of algae to remove nitrogen from the water, and then harvesting the algae. Various markets have been proposed for the use of algae. Two methods of bacterial denitrification being explored are pond denitrification, and filter denitrification. The three denitrification methods are compared as to land requirements and project costs. Each is nearly the same in cost - around $10 per acre foot, however the algae stripping method requires much more land. (White-Iowa State)

0488 - A1, F5

THE EFFECTS OF SALINITY STANDARDS ON IRRIGATED AGRICULTURE IN THE COLORADO RIVER BASIN,

Federal Water Pollution Control Administration, Boulder. Colorado River - Bonneville Basins Office.
Gary N. Dietrich, and L. Russell Freeman.
In: Water Quality Management Problems in Arid Regions, Water Pollution Control Research Series, 13030 DYY, 6/69, Oct 1970, USDI, Federal Water Quality Administration, p 9-15.

Descriptors: *Salinity, *Water quality, *Standards, Colorado River, *Irrigation, Evapotranspiration,

Desalination, Flow augmentation, Consumptive use, Water pollution effects.
Identifiers: *Salinity criteria, Irrigation cycle, Salinity-source abatement.

This paper discusses salinity criteria for the Colorado River Basin. The problem faced in water quality management in the Colorado River Basin is one of improving existing mineral quality, or at least, minimizing future salinity increases. Consumptive use of water in crop production complicates developing salinity criteria for the Colorado River Basin. There are only two direct approaches to implementing salinity criteria: the regulation of consumptive water uses and the desalination of waters whose salinity has been concentrated by consumptive use. Three salinity control approaches which do not necessarily depend on the establishment of criteria are: the abatement of salinity at selected sources including natural sources, the augmentation of river flows, and the desalination of water for use.
(White-Iowa State)

0489 - E3, F4

WATER QUALITY REQUIREMENTS AND REUSE OF WASTE WATER EFFLUENTS,
Federal Water Pollution Control Administration, Washington, D.C.
Stanley J. Dea.
In: Water Quality Management Problems in Arid Regions, Water Pollution Control Research Series, 13030 DYY, 6/69, Oct 1970, USDI, Federal Water Quality Administration, p 37-44. 1 tab.

Descriptors: *Water quality, *Waste water treatment, *Water reuse, Effluent, Waste water, Water Quality Act, Beneficial use, Water supply, Biological treatment, Sewage effluents, Filters, Activated sludge, Tertiary treatment.
Identifiers: *Nutrient removal.

From the overall view of potential water supply shortages in the United States, advanced waste treatment has the greatest promise at locations where the municipal waste water is presently discharged into the ocean or other sinks, and is lost for reuse. An advanced waste treatment facility for turning waste discharges into potable water is described for New York City. The most urgent needs in sewage treatment technology include modifications of 'conventional' processes and advanced or tertiary treatment. Advanced treatment for the removal of nutrients, organics, and inorganics can be accomplished for about 26-30 cents/1000 gallons compared to 11 cents/1000 gallons for secondary treatment. However, the reclaimed waste water from advanced treatment has economic utility and value for reuse.
(White-Iowa State)

0490 - A3, F5

SALINITY CONTROL IN RETURN FLOW FROM IRRIGATED AREAS - A DEMONSTRATION PROJECT,
Colorado State Univ., Fort Collins. Natural Resources Center.
Norman A. Evans.
In: Water Quality Management Problems in Arid Regions, Water Pollution Control Research Series, 13030 DYY, 6/69, Oct 1970, USDI, Federal Water Quality Administration, p 45-55. 7 fig.

Descriptors: *Salinity, *Return flow, *Irrigation, Colorado River, Salt balance, Canal seepage, Deep percolation, Evapotranspiration, Electrical conductance, Base flow.
Identifiers: Salt load.

The purpose of this paper was to summarize a demonstration project which has been initiated in the Grand Valley area of Colorado for the purpose of showing that saline agricultural return flows are controllable and that if improvements in water management practices are applied, the salt load returning to the river will be reduced. A discussion is given on the mechanics of return flow. Six irrigation companies, a power company, and a drainage district combined resources to form a corporation for the purpose of conducting the demonstration and study. The first step was a before treatment inventory of water and salt budget in the demonstration area. Canal seepage losses have been measured and a plan for lining certain sections is being formulated. Many water flow measurements are being made. Evapotranspiration estimates will be made. Groundwater flow will be calculated from hydraulic gradient and permeability data. Self-monitoring the Colorado River will afford the final evidence of positive benefit from reduction in canal seepage. The reduced canal seepage should reduce by 1/2 the volume of return flow, and affect a significant reduction in salt load.
(White-Iowa State)

0491 - A3, A5

WATER QUALITY CONTROL PROBLEMS IN INLAND SINKS,
Federal Water Pollution Control Administration, Alameda, Calif. California/Nevada Basins.
Richard C. Bain, Jr., and John T. Marlar.
In: Water Quality Management Problems in Arid Regions, Water Pollution Control Research Series, 13030 DYY, 6/69, Oct 1970, USDI, Federal Water Quality Administration, p 57-77. 8 fig, 2 tab, 10 ref.

Descriptors: *Water quality, *Salinity, *Sinks, Eutrophication, Fish, Dissolved oxygen, Temperature, Nutrients, Evaporation, Water level fluctuations, Nevada, California.
Identifiers: Pyramid Lake (Nev), Salton Sea (Calif), Total dissolved solids, Surface area.

The problems of Pyramid Lake, Nevada, and Salton Sea, California, are similar in many ways and are common to other inland sinks. Salinity increases and water level fluctuations attributable to water and salt inflows and evaporation losses may be controlled or abated through river basin and water quality management schemes. Pyramid Lake water levels and the rate of salinity increases can be controlled by increasing the water supply to the Lake. Salton Sea salinity and water level problems can be better controlled by salt extraction, lower irrigation efficiencies in nearby agricultural areas, bulkheading on developed parts of the shore, and possible future evaporation pond operation. Eutrophication symptoms, advanced in the Salton Sea and emerging in Pyramid Lake, are less easily manipulated. Natural forces of deposition and consumption of organic matter within these waters will tend to limit nutrient buildup; however trapping and predation effects alone will not eliminate algal blooms. Control of eutrophication must begin with control or elimination of major nutrient sources. It is clear that unless water quality control measures are taken, both bodies of water will eventually become aqueous deserts. Local, State and Federal efforts are underway to preserve or enhance the water quality and associated uses of these two inland sinks. (White-Iowa State)

0492 - D2, E3, F1

DISTILLATION OF WASTE WATERS: A WATER RESOURCE FOR ARID REGIONS,
Federal Water Pollution Control Administration, Washington, D.C. Office of Research and Development.
Allen Cywin, George Rey, Stanley Dea, and Harold Bernard.
In: Water Quality Management Problems in Arid Regions, Water Pollution Control Research Series, 13030 DYY, 6/69, Oct 1970, USDI, Federal Water Quality Administration, p 85-94. 14 ref, 2 fig, 1 tab.

Descriptors: *Distillation, *Waste water treatment, Effluent, Potable water, Water reuse, Water quality, Brackish water, Sewage treatment, Costs, Waste dilution, Demineralization, Water resources.
Identifiers: *Blowdown ratio, Salt removal, Mineral content, Total dissolved solids.

The authors propose distillation of municipal waste water for the production of low mineral content water for industrial purposes, particularly for those industries which require such water in large quantities. Distillation has previously been limited in arid regions to applications using saline waters as a feedwater supply. The use of waste water may very possibly result in less costly distilled water. A part of the waste water renovation costs can be attributed to pollution control. Dilution of tertiary-treated effluents with a lower mineral content municipal water can also produce a product water of acceptable mineral content. The lower concentrations of sulfate and total dissolved solids in waste water effluents is also advantageous. Total treatment costs for the processes involved are given.
(White-Iowa State)

0493 - A2, B1, C3

NUTRIENTS IN EFFLUENTS FROM ANIMAL PRODUCTION AREAS,
Missouri Univ., Columbia. Dept. of Agricultural Engineering; and North Carolina State Univ., Raleigh.
Jackie W. D. Robbins, George J. Kriz, and David H. Howells.
Paper presented at 1971 Mid-Central Meeting American Scociety Agricultural Engineers, Paper No MC-71-102. 20 p, 5 fig, 4 tab, 10 ref.

Descriptors: *Farm wastes, *Nutrients, *Coliforms, *Runoff, Management, Phosphate, Nitrogen, Biochemical oxygen demand, Bacteria, Farm lagoons, Pollutants, Disposal, Hogs, Poultry, Cattle, Waste water treatment.
Identifiers: Total coliform, Fecal coliform, Swine, Total Organic Carbon (TOC).

Twelve typical agricultural areas representing three types of animal waste management techniques--land spreading including pasture and drylot units, lagooning and direct discharge into streams--were studied to determine the amounts of and factors governing stream enrichment from swine, dairy, poultry and beef production operations. (Christenbury-Iowa State)

0494 - A6, B1

A MODEL STUDY TO DETERMINE THE EFFECTS OF VENTILATION SYSTEMS UPON NH3 CONCENTRATIONS IN SWINE CONFINEMENT HOUSING,
Ohio State Univ., Columbus. Dept. of Agricultural Engineering; and Nebraska Univ., Lincoln. Dept. of Agricultural Engineering.
C. N. Ifeadi, and J. A. DeShazer.
Paper presented 1971 Mid-Central Meeting American Society of Agricultural Engineers, Paper No MC-71-103. 9 p, 1 fig, 1 tab, 2 ref.

Descriptors: *Model studies, *Odors, *Ventilation, *Ammonia, Laboratory tests, Physical models, Structural models, Hogs, Air circulation, Statistical models, Farm wastes, Waste water treatment.
Identifiers: Slotted floors, Airflow rates, Inlet systems, Exhaust systems.

A plexiglass model 1/12 the size of an existing swine building was used to determine the effect of various ventilation systems upon the NH3 concentration in the model. From this investigation, it was found that as more air exhausted below the floor the concentration of NH3 above the floor decreased. Also the inlet settings influenced the concentration of NH3 above the floor. (Christenbury-Iowa State)

0495 - A3, F2

CONTAMINATION OF SURFACE WATERS FROM PLOWED-IN FEEDLOT MANURE,
Kansas State Univ., Manhattan. Dept. of Agricultural Engineering.
R. I. Lipper, H. L. Manges, and Eugene Goering.
Paper presented at the 1971 Mid-Central Meeting

American Society of Agricultural Engineers, Paper No MC-71-803. 4 p.

Descriptors: *Farm wastes, *Disposal, Confinement pens, Pollutants, Runoff, Chemical oxygen demand, Water pollution sources.
Identifiers: *Feedlot manure, Plowed-in.

When a four-inch layer of beef feedlot manure was completely covered with 2 to 3 inches of soil in small test plots, no organic contamination of water on the soil surface resulted when plots were well drained. Under conditions simulating standing water on tight soil, COD of the water was very high. (Christenbury-Iowa State)

0496 - B2, C3, D4

DESORPTION OF AMMONIA FROM ANAEROBIC LAGOON,
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
J. K. Koelliker, and J. R. Miner.
Journal Paper No J-6873 of Iowa Agricultural and Home Economics Experiment Station, Ames. Paper presented 1971 Mid-Central Meeting, American Society Agricultural Engineers, Paper No MC-71-804. 21 p, 6 fig, 2 tab, 9 ref. USDI Public Law 88-379, HEW EC 00283-02.

Descriptors: *Farm wastes, *Anaerobic digestion, Farm lagoons, Biodegradation, Ammonia, Hogs, Disposal, Temperature, Hydrogen ion concentration, Nitrogen cycle, Nitrogen compounds, Laboratory tests, *Mass transfer, *Waste water treatment.
Identifiers: *Anaerobic lagoons, *Nitrogen balance, Ammonia desorption, Nitrogen transformations, Swine.

The loss of ammonia from an anaerobic manure lagoon has been monitored by measurement of ammonia concentrations in air surrounding the lagoon and by a nitrogen balance for the same lagoon from Nov. 1969 - Oct. 1970. Theoretical considerations of desorption and data from the lagoon indicate that the nitrogen loss to the air can be predicted. An anaerobic lagoon may well be a nitrogen sink if no liquid must be removed from it. The rate of ammonia desorption from a lagoon surface is accelerated by increasing alkaline pH, higher temperatures, and increasing wind velocities. (Christenbury-Iowa State)

0497 - D1

DEHYDRATION OF ANIMAL WASTES,
Agricultural Research Service, Columbia, Mo. Transportation and Facilities Research Div.
Herman F. Mayes.
Paper presented at the 1971 Mid-Central Meeting American Society of Agricultural Engineers, Paper No MC-71-805. 15 p, 2 fig, 4 ref.

Descriptors: *Farm wastes, *Fertilizers, *Dehydration, Disposal, Livestock, Economics, Marketing, Economic feasibility, Operating, Storage, Operating costs, Operation and maintenance, Costs, Waste treatment.
Identifiers: Dehydrator design.

Four large terminal livestock markets have been dehydrating cattle and sheep manure since the early 1950's. The dehydrated manure is being merchandised as a specialty fertilizer. The design features of these dehydrators, the operating problems and some typical operating costs are reviewed. These markets have shown that animal wastes can be dehydrated and marketed. While a profit may not have been realized from the sale of this dehydrated manure, it may have been the cheapest method of disposal. (Christenbury-Iowa State)

0498 - A2, B1, F1

WATER POLLUTION CONTROL IN CATTLE FEEDLOTS,
Robert S. Kerr Water Research Center, Ada, Okla.
J. L. Witherow, and M. R. Scalf.
Mimeo, September 1970, 2 fig. EPA Program 13040---09/70.

Descriptors: *Farm wastes, *Water pollution sources, Cattle, Surface runoff, Waste disposal, Waste water disposal, Waste water treatment, Feed lots, Livestock, Confinement pens, Management.

The nature and cause of water pollution from cattle feedlots is briefly described. Current waste management alternatives are dependent upon the rational for land disposal. Two major research projects are described on irrigation with rainfall runoff from the feedpen and on rates of manure disposal on crop lands. Unconventional waste management alternatives involve production process change, reuse of waste through pyrolysis, or refeeding and redesign of the production facilities. (EPA abstract)

0499 - C1, D4

MANURE LAGOONS......DESIGN CRITERIA AND MANAGEMENT,
Maryland Univ., College Park. Dept. of Agricultural Engineering.
Harry J. Eby.
ASAE Paper No 61-935. Agricultural Engineering Journal, Vol 43, p 698-701, 714-715, Dec 1962. 6 fig, 1 tab, 19 ref.

Descriptors: *Farm lagoons, *Design criteria, Water temperature, Sewage treatment, Aerobic bacteria, Aquatic plants, Anaerobic bacteria, Algae, Biochemical oxygen demand, Oxidation lagoons, Sludge, Photosynthetic oxygen, Farm wastes, Waste water treatment.
Identifiers: *Site selection, Loading.

Criteria to be considered when designing a lagoon for treatment of wastes produced by animals in confinement is discussed. It mentions situations where lagoons would not be feasible. Seven criteria for site selection are given. The physical, chemical and biological factors discussed include temperature, light, specific gravity, mixing, nutritional effects, pH effects, toxic effects, and interrelationship of biological species. Also mentioned is the algal-bacterial relationship. Design factors for size and volume are given. The article concludes with management problems encountered such as floating debris, overloading, intermittent loading, aquatic weeds and sludge build-up. (Parker-Iowa State)

0500 - A5, D4

ANAEROBIC LAGOONS: CONSIDERATIONS IN DESIGN AND APPLICATION,
Cornell Univ., Ithaca, N.Y.
Raymond C. Loehr.
Transactions of the American Society of Agricultural Engineers, Vol 11, p 320-322 and 330, 1968. 2 fig, 4 tab, 14 ref.

Descriptors: *Farm lagoons, *Anaerobic digestion, *Design, *Solids, Anaerobic conditions, Farm wastes, Temperature, Gases, Biochemical oxygen demand, Waste water treatment.
Identifiers: *Solids removal, Loading, Gas production, effluent quality.

Design and application of anaerobic lagoons for treatment of wastes from farm animals in confinement is described. The purpose for anaerobic lagoons is given in relation to aerobic lagoons and other treatment systems. The article proceeds to discuss size requirements, loading restrictions and mixing, both natural and mechanical as required. Quantities and quality of gas production are discussed as well as temperature relationships to gas production and other operating conditions. A short analysis of effluent quality is presented. Solids removal is discussed in some length. The article concludes by mentioning some difficulties such as potent effluent, warm temperature requirements and odors due to biochemical imbalance. (Parker-Iowa State)

0501 - A8, D4

INVESTIGATIONS ON FLY CONTROL BY COMPOSTING POULTRY MANURES,
Orange County Health Department, Santa Ana, Calif.
Roy E. Eastwood, Jimmy M. Kade, Robert B. Schoenburg, and Harold W. Brydon.
Journal of Economic Entomology, Vol 60, No 1, p 88-98, Feb 1967. 7 fig, 7 tab, 5 ref.

Descriptors: *Farm wastes, *Poultry, Aerobic conditions, Temperature, Degradation, Decomposing organic matter, Aeration, Mixing, Larvae, Bulk density, Volume, Moisture content, Nitrogen.
Identifiers: *Composting, Fly problems, Fly pupae, Windrows.

Windrow composting of poultry manure was investigated during several months of the year. Results obtained indicated that manure does not have to be ground prior to composting. Bulking and drying materials are not required in composting poultry manure. Fly larvae were reduced in numbers during the composting process so that they would not create a fly problem. Poultry manure once composted is not suitable as an oviposition site for adult flies and the subsequent development of larvae. A twice-weekly turning schedule with a manure spreader is desirable to help prevent fly larvae from pupating and emerging by bringing them into contact with the hot interior of the pile. (White-Iowa State)

0502 - B2, C3

MANURE PRODUCTION BY BROILERS,
Maine Univ., Orono. Dept. of Animal Science.
R. W. Gerry.
Poultry Science, Vol 47, p 339-340, 1968. 2 tab, 4 ref.

Descriptors: *Farm wastes, *Poultry, Feeds, Moisture content, Calcium, Phosphorus, Proteins.
Identifiers: *Manure production, Poultry litter, Broilers, Dry droppings, Wood shavings, Crude protein.

A test was conducted in which White Mountain x White Rock cross broiler were reared to 53 days of age and fed a modified New England College Conference starting ration. Actual production of dry matter which did not include the bedding or the moisture in the litter was 867 kilograms per 1000 males, 658 kilograms per 1000 females, and 748 kilograms per 1000 mixed sexes. The average amount of manure (litter) removed at the end of the test period was 1602 kilograms per 1000 birds. This litter included an average of about 500 kilograms of wood shavings per 1000 birds and analyzed 23 percent moisture. During the test period there was a marked increase in crude protein, calcium and phosphorus content of the litter. (White-Iowa State)

0503 - C4

THE MICROBIOLOGY OF BUILT UP POULTRY LITTER,
Edinburgh Univ. (Scotland). Dept. of Bacteriology.
Henrietta Schefferle.
Journal Applied Bacteriology, Vol 28, No 3, p 403-411, 1965. 5 tab, 7 ref.

Descriptors: *Microbiology, *Bacteria, Farm wastes, Poultry, Odor, Fungi, Aerobic conditions, Laboratory tests, Alkalinity, Enteric bacteria, Lac-

tobacillus, Hydrogen ion concentration, Temperature, Moisture content.
Identifiers: Litter, Coryneform bacteria, Enterococci.

The numbers of viable bacteria in built up poultry litter were found to be 10 to the 10th power - 10 to the 11th power/g fresh weight and appeared to be little affected by factors such as age, temperature, moisture content and pH. Counts for unused litter and poultry droppings were lower. In built up litter of high alkalinity coryneform bacteria were predominant, micrococci occurred sporadically and small numbers of nocardias, streptomycetes, aerobic spore formers and streptococci were encountered. A variety of Gram negative bacteria also occurred, the numbers of which appeared to be controlled by alkalinity; they were less abundant in litters where the pH and buffering capacity were high. Strongly alkaline conditions also tended to lower the fungal counts but had no effect on the count of enterococci. (Christenbury-Iowa State)

0504 - D2, F1

COST OF DEHYDRATING POULTRY MANURE.

Poultry Digest, p 143, Mar 1971.

Descriptors: *Farm wastes, *Dehydration, *Costs, Poultry, Equipment, Fertilizers, *Waste treatment.
Identifiers: Shelf life.

Conventional dehydrating equipment is available for drying poultry manure. However, the cost of the processed manure is likely to exceed $20 per ton. A two-stage drying process has been developed that brings the cost down to $7.60 per ton for a product with 10% moisture. The final product is a fine powder, free of offensive odors, has shelf life and it has the qualities required for sale as an organic fertilizer. It contains 4 to 5% nitrogen, 3% phosphoric acid, and 2.5% potash. (Christenbury-Iowa State)

0505 - B1, C5

CONFINEMENT REARING OF TURKEYS,
Amerine National Corp., Oakdale, Calif. Hastings Div.
Douglas C. Ferebee.
Poultry Digest, p 110-112, Mar 1971. 2 fig.

Descriptors: *Ventilation, *Management, *Confinement pens, Farm wastes, Equipment, Hazards, Poultry, Water pollution control.
Identifiers: *Psychrometric chart, Overventilation, Turkeys.

Some management functions that can lead to maximzing returns from turkey production are discussed. To get the most out of any ventilation system, whether it is positive or negative pressure, knowledge of psychrometrics by the person doing the ventilating is essential. It is possible to overventilate a total confinement house or to underventilate it. Much can be gained from having thermostats located outside where outdoor conditions can be used to provide a better environment inside. Good, not necessarily new, in-house equipment is vital for optimum results from confinement production. (Christenbury-Iowa State)

0506 - A2, C2

CATTLE FEEDLOT RUNOFF - ITS NATURE AND VARIATION,
Kansas State Univ., Manhattan. Dept. of Agricultural Engineering.
J. R. Miner, R. I. Lipper, L. R. Fina, and J. W. Funk.
Journal Water Pollution Control Federation, Vol 38, p 1582-1591, 1966. 8 fig, 11 tab, 12 ref.

Descriptors: *Farm wastes, *Runoff, *Bacteria, Cattle, Simulated rainfall, Hydrographs, Chemical oxygen demand, Biochemical oxygen demand, Nitrogen, Temperature, Pollutants, Water pollution sources.
Identifiers: Kjeidahl nitrogen, Feedlot runoff, Suspended solids, Chemical quality, Most probable number.

Runoff from cattle feedlots is a high-strength organic waste produced during and immediately after rainfall. These studies indicated that greatest pollutant concentrations are obtained during warm weather, during periods of low rainfall intensity, and when the manure has been made soluble by soaking with water. Correlations were developed to predict runoff oxygen demand and nitrogen content based on these factors. In addition, the following points were demonstrated: (1) Feedlot runoff is a source of high concentrations of bacteria normally considered as indices of sanitary quality, and (2) runoff from a concrete-surfaced lot was more heavily polluted than that from a nonsurfaced lot under similar conditions. (Christenbury-Iowa State)

0507 - E1, F4

ANIMAL WASTES,
Guelph Univ. (Ontario). Dept. of Soil Science.
L. R. Webber.
Journal of Soil and Water Conservation. Vol 26, No 2, p 47-50, Mar-Apr 1971. 21 ref.

Descriptors: *Farm wastes, *Disposal, Pollutants, Pollution abatement, Groundwater, Farm lagoons, Treatment, Anaerobic digestion, Aerobic treatment, Management, Water pollution sources.
Identifiers: Contamination, Feedlots, Waste removal, Composting.

Some waste management problems resulting from high-density confinement of livestock are discussed. Treatment and disposal of the waste material causes the most troublesome problems. There are many systems in use, with anaerobic or aerobic lagoon treatment more common. Man has always used land as the ultimate disposal medium for many kinds of waste. Agriculture finds itself in the challenging position of being able to use or dispose of vast quantities of animal wastes without polluting the water, soil, or air. (Christenbury-Iowa State)

0508 - A5, A6, C3

AIR POLLUTION FROM ANIMAL WASTES,
Cornell Univ., Ithaca, N.Y. Dept. of Food Science.
William E. Burnett.
Environmental Science and Technology, Vol 3, No 8, p 744-749, Aug 1969. 6 fig, 2 tab, 21 ref. N.Y. State Dept. of Health C-1101 USDA. ARS 12-14-100-9092 (44).

Descriptors: *Farm wastes, *Pollutant identification, *Odor, Air pollution, Gas chromatography, Organic compounds, Organic acids, Aromatic compounds, Poultry, Laboratory tests.
Identifiers: *Malodor, *Odorous compounds, *Odor identification, Liquid poultry manure.

A combination of gas chromatographic and organoleptic techniques was used to determine the chemical compounds responsible for the offensive odor of accumulated liquid poultry manure. The volatile odorous substances were trapped and concentrated in short sections of gas chromatographic columns held at -78C., separated by gas chromatography and identified by the correspondence between relative retention time and the odors of the peaks for the unknowns and authentic compounds. Mercaptans, sulfides, and diketones were identified. Volatile organic acids and the nitrogen heterocycles, indole and skatole, were also identified, using direct injections of liquid manure supernatant and standard gas chromatographic techniques. The sulfur compounds, organic acids, and skatole were implicated as important malodorous components involved in air pollution. The prevention of the formation of the malodorous substances was suggested as the best means of control of air pollution from animal wastes. (Hazen-Iowa State)

0509 - C3

THE METAL COMPLEXING CAPACITY AND THE NATURE OF THE CHELATING LIGANDS OF WATER EXTRACT OF POULTRY LITTER,
Georgia, Univ., Athens. Dept. of Agronomy.
K. H. Tan, R. A. Leonard, A. R. Bertrand, and S. R. Wilkinson.
Georgia Agr. Exp. Sta. Journal Series Paper No. 760. Soil Science Society of American Proceedings, Vol 35, No 2, p 265-269, Mar 1971. 3 fig, 1 tab, 23 ref.

Descriptors: *Farm wastes, *Organic matter, *Organic wastes, *Infrared radiation, Chelation, Analytical techniques, Chemical reactions, Laboratory tests.
Identifiers: *Poultry litter, *Infrared identification, Infrared analysis, Organic waste products, Complexing agents, Chelating ligands.

The metal complexing capacity and the nature of the chelating legands of organic matter extracted from broiled house litter were studied by ion-exchange equilbrium and dissolution methods and infrared to exhibit a significant chelating effect on the equations Cu2.., 2n2.., Mg2.., and Al3... The amount of organic matter complexed by one mole of metal and the stability of metal complexes increased with increasing pH in the cases of Cu-, Mg-, and Al- complexes. Infrared analysis revealed spectograms of the ligands similar to those obtained by polysaccharides. Functional group frequency vibration comparisons ar 3,500, 3,200, 1,650, and 1,400 cm-1 showed that the formation of stable metal complexes involved carboxyc electrovalent linkages and probably hydroxyl and/or amino coordinate linkages. (Hazen-Iowa State)

0510 - C1, D1, E1

CATTLE, SWINE AND CHICKEN MANURE CHALLENGES WASTE DISPOSAL METHODS,
Connecticut Univ., Storrs.
R. Laak.
Water and Sewage Works, Vol 117, No 4, p 134-138, April 1970. 8 tab, 30 ref.

Descriptors: *Agriculture, *Cattle, Waste water (Pollution), Costs, Nitrogen, Phosphorous, Potash, Fertilizers, Disposal, Pollution, Livestock, *Hogs, Poultry, Nitrogen compounds, Phosphorus compounds, *Farm wastes.
Identifiers: Chicken, Feedlots.

In the United States today approximately 0.66 billion lbs per day of manure must be extensively treated or destroyed. The trends in agriculture indicate that more livestock will be confined in the future, the concentration of the wastes increased, and the volume of manure per animal slowly reduced. Extensive data was collected and is presented giving the general characteristics of feces and urine of cattle, swine, and poultry as well as the quantitative consumption of feed, nitrogen, phosphorous, and potash. The manure characteristics are said to be changing and therefore the treatment process principles must also be changed. Costs and land requirements are given for manure disposal and an extensive outline enumerates the large variety of available disposal methods along with each one's particular drawback. The average cost of manure separation and final disposal must be a fraction of $3 to $40 per ton. (Hancuff-Texas)

0511 - C1, C5, E3

ANIMAL WASTE REUSE--NUTRITIVE VALUE AND POTENTIAL PROBLEMS FROM FEED ADDITIVES--A REVIEW.

Agricultural Research Service, Beltsville, Md. Animal Science Research.

ARS 44-244, Feb 1971. 56 p, 3 tab, 184 ref.

Descriptors: *Farm wastes, *Additives, *Feeds, Ruminants, Poultry, Cattle, Diets, Hazards, Hogs, Biodegradation, Pathogenic bacteria, Larvicides, Pest control, Organophosphorus, Nutrients.
Identifiers: *Literature review, *Residues, Swine, Hormones, Antibiotics, Disease control, Growth adjuvants, Excretion data, Registration, Non-nutritive.

This is a report of literature on the nutritional value of animal wastes and the potential problems that may occur when compounds other than nutrients are added to animal feed. The non-nutritive feed additives discussed are as follows: Pellet binders, flavoring agents, enzymes, Antibiotics, arsenicals, nitrofurans, (low level feeding); Antifungals, larvicides, Broad-spectrum, absorbable antibiotics (high level therapeutic use); Chemicals used to potentiate curative properties of antibiotics; Coccidiostats, worming drugs, antioxidants; Carotenoid sources, hormones, Reserpine, aspirin, and tranquilizing drugs. (White-Iowa State)

0512 - C5

FECAL RESIDUES FROM FEED ADDITIVES--POULTRY,
Agricultural Research Service, Beltsville, Md. Animal Science Research.
C. C. Calvert.
In: Animal Waste Reuse--Nutritive Value and Potential Problems from Feed Additives--A Review. ARS 44-224, p 14-19, Feb 1971.

Descriptors: *Additives, *Feeds, *Poultry, Farm wastes, Pollutants, Diets, Hazards, Water pollution.
Identifiers: Antibiotics, Arsenicals, Nitrofurans, Growth adjuvants, Soil pollution.

To keep pace with the increased demand for eggs and poultry meat, the feed manufacturers and producers have used more and more feed additives. There is a concern with what these additives may contribute to air, soil, and water pollution after they have performed whatever function they may have in the animal body. The nonnutritive feed additives commonly found in poultry feed are discussed. These include pellet binders, flavoring agents, enzymes, antibiotics, arsenicals, and nitrofurans, antifungal agents, coccidiostats and worming drugs, antioxidants, carotenoid sources, hormones, reserpine, aspirin and tranquilizing drugs are being added to poultry feeds. (See also (Christenbury-Iowa State)

0513 - C3, C5

FECAL RESIDUES FROM FEED ADDITIVES--SWINE,
Agricultural Research Service, Beltsville, Md. Animal Science Research.
L. T. Frobish.
In: Animal Waste Reuse--Nutritive Value and Potential Problems from Feed Additives--A Review. ARS 44-224, p 19-27, Feb 1971.

Descriptors: *Additives, *Hogs, *Feeds, Farm wastes, Hazards, Pollutants, Growth rates, Diets.
Identifiers: Swine, Diethylstilbestrol.

This paper discusses the major feed additives associated with swine production. They are antibiotics, arsenicals, copper, nitrofurans, sulfonamides and hormones. Many compounds have been used for the treatment of specific diseases in swine but when incorporated into the diet at low levels may have growth promoting properties. There is little available information on the metabolites of antibiotic degradation, their excretion, and possible distribution in the soil and finally into plants. Arsanilic acid is the most common arsenical compound used in swine diets. There is very limited data on excretion of many of the additives and their subsequent effect on the environment.
(Christenbury-Iowa State)

0514 - C3, C5

FECAL RESIDUES FROM HORMONES AND ANTIBIOTICS--BEEF CATTLE,
Agricultural Research Service, Beltsville, Md. Animal Science Research.
D. A. Dinius.
In: Animal Waste Reuse--Nutritive Value and Potential Problems from Feed Additives--A Review. ARS 44-224, p 27-32, Feb 1971.

Descriptors: Farm wastes, Cattle, Feeds, Diets, Degradation (Decomposition), Biodegradation.
Identifiers: *Hormones, *Antibiotics, Disease control, Concentrations, Implant, Excretion data.

The interest in hormones excreted by animals which may be recycled through plants and back to man or animals is with the natural and synthetic estrogens, androgens, and progestins. This discussion deals only with these. Other hormones, such as follicle stimulating hormone and luteinizing hormone, may be present in animal excreta but they occur in small concentrations and are readily biodegradable, thus, they are of little ecological concern. Certain antibiotics are frequently added to the high-grain ratios commonly fed to finishing beef cattle. A review summarizing some of the research that has been conducted with these antibiotics, particularly in reference to the potential for recycling through feedstuffs is presented. Plants will not absorb from the soil measurable quantities of the antibiotics commonly fed to cattle.
(Christenbury-Iowa State)

0515 - A8, C5

FECAL RESIDUES FROM LARVICIDES--POULTRY AND CATTLE,
Agricultural Research Service, Beltsville, Md. Animal Science Research.
R. W. Miller.
Also in Bulletin of the Entomological Society of America as Larvicides for Fly Control - A Review, by R. W. Miller, Vol 16, No 3, p 154-158, Sept 1970. In: Animal Waste Reuse--Nutritive Value and Potential Problems from Feed Additives--A Review. ARS 44-224, p 33-41, Feb 1971. 2 tab.

Descriptors: *Farm wastes, *Larvicides, Larvae, Pathogenic bacteria, Boron, Organophosphorus, Pesticides, Cattle, Poultry, Feeds, Pesticide residues, Pest control.
Identifiers: Fly larvae, Feed additives, Residues, Fly control, Animal manures, Registration.

One of the best methods for control of flies is through the use of larvicides, applied either directly to the manure, or as a feed additive. Research was conducted as early as 1928 on feed additives to make the feces unfavorable for the development of horn fly larvae. In 1954, organophosphorus insecticides began receiving a great deal of attention as possible feed-additive larvicides for the control of flies around both poultry and cattle operations. Although a great deal of research has been conducted on find suitable feed-additive larvicides for fly control around poultry and cattle manure, no insecticides are registered for commercial feed-additive use with poultry and only one has a registration for use with lactating dairy cattle. Three insecticides have registrations for feed-additive use with beef cattle. (Christenbury-Iowa State)

0516 - F4

PROCEEDINGS OF FARM ANIMAL WASTE AND BY-PRODUCT MANAGEMENT CONFERENCE,
Wisconsin Univ., Madison.
University Extension, The University of Wisconsin, November 6-7, 1969. 129 p.

Descriptors: *Farm wastes, *Cattle, *Hogs, *Poultry, *Environment, Social aspects, Economic, Political aspects, Psychological aspects, Air pollution, Water pollution, Soil contamination.
Identifiers: *Management conference.

This conference was held for technical and administrative staff of local, state, regional and federal agencies; for industries and for private citizens who are concerned about or have a responsibility related to the proper management of wastes from farm animal enterprises in Wisconsin. It was an introductory meeting at which the dimensions of the problems were examined, research was reviewed, some alternative manure handling methods were highlighted, public agency roles were outlined and two existing local programs were described. Small group discussions explored future program and research needs. (White-Iowa State)

0517 - C1

QUANTITIES AND CHARACTERISTICS OF FARM-ANIMAL WASTES,
Public Health Service, Chicago, Ill. Bureau of Solid Waste Management.
Ralph J. Black, and William Q. Kehr.
In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, November 6-7, 1969, p 17-21. 3 tab, 6 ref.

Descriptors: *Farm wastes, *Water pollution, Population, Pollution abatement, Confinement pens, California, Solid wastes, Dissolved oxygen, Water quality, Hogs, Cattle, Poultry, Nutrients, Sewage sludge.
Identifiers: Meat consumption, Livestock production, Population equivalent, Land disposal.

The paper points out that an increased population will require much more beef and poultry, thus increasing the agricultural waste problem. Confinement feeding is firmly established, and, while the number of feeding operations is expected to decline, the total production will be increased. The importance of agricultural wastes is brought out in a table showing quantities of solid wastes generated in California. This is magnified by population equivalent data which states that animal wastes were equivalent in pollutional affect to 10 times that of the nation's population. Data is presented on quantities produced and the nutrient value of animal wastes. It is economically unfeasible to utilize this waste for its fertilizer value. The quantity of animal wastes will increase, as will the management problems associated with its handling, treatment and disposal. (White-Iowa State)

0518 - A3, A9

HEALTH PROBLEMS,
Wisconsin Univ., Madison. Dept. of Bacteriology.
Elizabeth McCoy.
In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, November 6-7, 1969, p 22-24.

Descriptors: *Public health, *Farm wastes, *Bacteria, Water pollution, Soil contamination, Coliforms, E. Coli, Streptococcus, Soil, Loam, Rates of application, Sampling, Cores, Adsorption, Percolation.
Identifiers: *Enterocci, Miami silt loam, Die-off.

Animal wastes contain enormous amounts of pollution bacteria. If it finds its way to surface or well waters the water would be reported as 'contaminated.' Bacterial counts made on fresh feces gave the following values: Coliform, 100,000 - 1,000,000/gm., Enterococci, 1,000,000 - 10,000,000/gm. Experiments were done to trace pollution bacteria in manure applied to soil. Five gallon pails (with bottoms cut out) were set to

about three-fourths of their depth in a field of Miami silt loam. Applications of a manure/water slurry were made in 15, 30, and 80 tons per acre amounts. Both types of bacteria were adsorbed with 598..% removal by 14 inches. The soil acts as a very efficient filter. (White- Iowa State)

0519 - A5, A10

AESTHETICS AND ODORS,
Wisconsin Dept. of Natural Resources, Madison.
Douglas Evans.
In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, November 6-7, 1969, p 25-26.

Descriptors: *Farm wastes, *Odors, Aesthetics, Anaerobic conditions, Hydrogen sulfirie.
Identifiers: *Odor threshold, Public nuisance, Odor panel, Odor measurement.

The difficulty of evaluating the offensiveness of odors is their subjective nature. Odors from farm animal wastes, particularly anaerobically generated are, in general, offensive, but the substances involved and the thresholds of detection are little known. Typical odor thresholds are given when determined by a trained panel. A method is outlined for eliminating panel members insensitive to odors. More needs to be known about the type, quantity and odor threshold of the various compounds involved in farm animal wastes. From this better methods of treating, storing, handling and disposing of wastes may be developed which will reduce or eliminate the odor problem.
(White-Iowa State)

0520 - A1, B1

DEAD ANIMALS AND HOW THEY CONTRIBUTE TO POLLUTION OF THE ENVIRONMENT,
Department of Agriculture, Madison, Wis.
A. A. Erdmann.
In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, November 6-7, 1969, p 27-29.

Descriptors: Transportation, Costs, Livestock, Legislation, Water pollution, Environment, Wisconsin.
Identifiers: *Dead animal disposal, *Rendering plants, Slaughter plant scraps, Carcasses.

The article describes why dead animals are fast becoming a pollution problem. Where once rendering plants paid to pick up dead animals they now charge livestock owners a fee for pick-up and disposal of livestock losses. The number of dead animals being sent to rendering plants has decreased by about 50%. Some legislation concerning the problem is encouraging. The author expects the problem of dead animal disposal to increase in the future. The problems of the rendering plant industry, such as added labor costs, collection costs, and, perhaps most important, the inferior product resulting from such operations, will probably make it necessary to use a different method of disposal of dead animals than is now followed.
(White-Iowa State)

0521 - A3, C3

WATER QUALITY PROBLEMS,
Wisconsin Dept. of Natural Resources, Madison.
F. H. Schraufnagel.
In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, p 30-32 November 6-7, 1969. 7 ref.

Descriptors: *Water quality, *Farm wastes, Water pollution sources, Fishkill, Fish, Dissolved oxygen, Nutrients, Nitrogen, Nitrates, Phosphorus, Eutrophication, Base flow, Ammonia, Coliforms, Cattle, Wisconsin.
Identifiers: *Land disposal, Concentrations, Feedlots.

Probably the biggest concern in Wisconsin about pollution from farm animal wastes is because of their nutrients. Nitrogen and phosphorus are the two significant nutrients causing eutrophication in lakes and streams. Land disposal is usually an effective way to prevent pollution except when wastes are applied to frozen ground. Data from the nutrient content of base flows generally indicates that percolation through the ground eliminates most of the phosphorus and nitrogen. The potential for pollution from animal wastes is very great. The likelihood of pollution from cattle will increase with manure fluidization and water carriage systems. The maintenance of water quality depends on research and development of techniques to control the problem. (White- Iowa State)

0522 - F4

FUTURE TRENDS IN LIVESTOCK PRODUCTION,
Wisconsin Univ., Madison. Coll. of Agriculture.
Robert W. Bray.
In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, p 33-35, November 6-7, 1969.

Descriptors: *Farm wastes, *Livestock, Cattle, Poultry, Hogs, Automation, Confinement pens, Odors, Waste disposal.
Identifiers: *Livestock numbers, Dairy cattle, Beef cattle, Feedlots, Horses, Waste management.

The author summarizes the article by saying that (1) livestock numbers will increase in the future and (2) the most economical management systems for all classes of livestock will result in larger numbers and more confinement in each livestock enterprise. Thus, the solid waste management or disposal problems associated with livestock production in Wisconsin will become more complex. The author gives his ideas as to what changes in production can be expected for dairy, beef, swine, poultry, and other operations.
(White-Iowa State)

0523 - A1, B1, F4

WHAT AND WHERE ARE THE CRITICAL SITUATIONS WITH FARM ANIMAL WASTES AND BY-PRODUCTS IN WISCONSIN,
Wisconsin Univ., Madison.
M. T. Beatty, J. E. Kerrigan, and W. K. Porter.
In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, p 36-57, November 6-7, 1969. 4 tab, 12 fig.

Descriptors: *Farm wastes, *Wisconsin, *Spatial distribution, Environment, Soils, Surface waters, Groundwater, Land resources, Livestock, Cattle, Hogs, Poultry, Population, Geology, Hydrology, Precipitation, Standards, Water quality, Nitrogen, Nitrates, Odor, Watersheds, Bedrock.
Identifiers: *By-products, Earth resources, Soil associations, Critical situations.

Where and to what extent various kinds of critical situations develop, depends on the interaction of several components of the waste production and management system. These include: the kinds and amounts of wastes and by-products produced, the spatial distribution of the sources, the proximity to people, the physical environment- characteristics of the soils, the landscape, the surface water and groundwater systems, and, the uses and demands on water and land resources. Numerous tables and charts point up the importance of these components. Seven critical situations, the problems and locations involved, are then explained. They include livestock concentrations near urban areas, large livestock concentrations, livestock in watersheds with lakes, and livestock concentrations on shallow soils over previous bedrock as well as others. (White-Iowa State)

0524 - B1

CONSIDERATIONS IN SELECTING DAIRY MANURE DISPOSAL SYSTEMS,
Wisconsin Univ., Madison. Dept. of Agricultural Engineering.
O. I. Berge, E. G. Bruns, T. J. Brevik, and L. A. Brooks.
In: Proceedings of the Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, p 58-69, November 6-7, 1969. 10 tab, 1 fig, 1 ref.

Descriptors: *Farm wastes, *Cattle, Labor, Odor, Investment, Storage, Storage tanks, Annual costs, Value, Nitrogen, Phosphorus, Potassium, Urine, Equipment, Wisconsin.
Identifiers: *Dairy cattle, *Manure disposal systems, Hauling, Stacking, Manure handling.

Different methods of handling dairy manure and disposing of it are discussed. Advantages and disadvantages are listed. The three basic systems include daily hauling, stacking, and liquid manure storage. Investment and annual costs are compared for the three systems under similar stanchion and free stall housing operations. Dairy manure is valued at $1.40/ton for its nutrient content. Various types of handling equipment are discussed as well as a few disposal methods. (White- Iowa State)

0525 - D4

ENGINEERING RESEARCH ON FARM ANIMAL MANURE,
Wisconsin Univ., Madison. Dept. of Agricultural Engineering.
Clyde Barth.
In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, p 70-79, November 6-7, 1969. 2 tab, 6 ref.

Descriptors: *Farm wastes, *Biological treatment, Disposal, Livestock, Anaerobic digestion, Waste storage, Lagoons, Aerobic treatment, Waste dilution, Temperature, Rotors, Irrigation, Odor, Gases.
Identifiers: *Waste management, Waste characteristics, Anaerobic lagoon, Aerobic lagoon, Oxidation ditch, Composting, BOD removal, Land application, Coprophagy, Chemical treatment, Solid-manure waste.

The article reviews different treatment and disposal methods which are currently being used or investigated. Anaerobic and aerobic lagoons are used but are limited by temperature and odor problems. The oxidation ditch can be used for swine but its use is uncertain for wastes from other livestock. Composting, though effective, lacks a market for its finished product. Land application continues to be the most widely used type of livestock waste disposal. Irrigation and plow-furrow-cover applications are a modification of land disposal. Chemical treatment, dehydration, incineration, and coprophagy are being studied, but no conclusions have been drawn. Odor and gas production are problems not well understood and difficult to control. Solid manure, because of the lack of problems associated with its handling, deserves serious consideration in any animal waste handling situation.
(White-Iowa State)

0526 - F4

NATION-WIDE RESEARCH ON ANIMAL WASTE DISPOSAL,
Federal Water Pollution Control Administration, Chicago, Ill. Lake Michigan Basin Office.
Jacob O. Dumelle.
In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Ex-

tension, University of Wisconsin, p 80-81, November 6-7, 1969.

Descriptors: *Farm wastes, *Research and development, Grants, Algae, Air pollution, Water pollution, Soil contamination, Nutrients.
Identifiers: *FWPCA, Activated algae, Feedlots, Oxidation ditch.

The article gives brief descriptions of research projects which the Federal Water Pollution Control Administration is helping to fund. One such project under way in California is trying to determine the practicability of producing and harvesting algae to remove nutrients from agricultural drainage waters. Other projects involve cattle feedlot runoff, and dairy waste waters. Besides research on treatment methods, some projects are trying to find out how much nutrient runs off, and how much gets into water. (White-Iowa State)

0527 - A1
WATER RESOURCES CENTER RESEARCH ON ANIMAL WASTES AND WATER QUALITY,
Wisconsin Univ., Madison. Water Resources Center.
J. E. Kerrigan.
In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, p 82-85, November 6-7, 1969.

Descriptors: *Farm wastes, *Water quality, Eutrophication, Research and development, Wisconsin, Legislation, Water resources, Environment, Resources.
Identifiers: *Water Resources Center, Water research.

The function and goals of the University of Wisconsin's Water Resources Center are pointed out. The Center got its start from faculty committees formed to study groundwater and subsequently lakes and streams. It was then assigned state responsibility by the legislature for the coordination and administration of an interagency water resources research and data collection program. Lists of objectives and functions of the Water Resources Center are given. If Wisconsin is to have a well balanced research program for water quality management, it is necessary to direct the limited available financial support to researchers with specially developed talents to solve specific problems that merit consideration. A generous amount of effort must be expended to identify the real problems. (White-Iowa State)

0528 - F4
THERE'S HOPE AHEAD,
Wisconsin Univ., Madison. Dept. of Poultry Science.
John Skinner.
In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, p 86-90, November 6-7, 1969.

Descriptors: *Farm wastes, *Odor, Land use, Population, Management, Poultry, Foods, Agriculture.
Identifiers: Manure handling, Public relations, Goals, Land use planning.

Examples are cited of problems which have been turned into profitable industries, this can also be done with animal wastes. The increasing urban population will demand that animal wastes and their associated odors be disposed of at least cost to the meat consuming public. We must first dedicate ourselves to finding answers to the animal waste disposal problem. We must have full realization and appreciation of the cause, extent and consequences of the problem by all concerned. Better land use planning is needed as well as progressive regulations and laws. Better public relations must be created for all of agriculture and agriculturally related industries. Emphasis is placed on realizing the consequences of what we are doing today. The author proposes a goal of 'rendering inoffensive those parts of animal waste and by-products which are disagreeable to the public in general.' (White-Iowa State)

0529 - F3
INTRODUCTION TO FEDERAL, STATE AND LOCAL ACTION PROGRAMS TO SOLVE ANIMAL WASTE DISPOSAL PROBLEMS,
Wisconsin Univ., Madison. Dept. of Agricultural Economics.
Douglas A. Yanggen.
In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, p 91, November 6-7, 1969.

Descriptors: *Farm wastes, Water pollution, Agriculture, Environment, Government supports, Cost sharing, Education, Regulation.
Identifiers: *Government programs, Technical assistance, Subsidy.

An introduction is given for following articles on governmental programs which include technical assistance, cost sharing, regulation and education at federal, state and local levels. Those included illustrate the various techniques for influencing private decision making. (White-Iowa State)

0530 - B1, F2
THE ROLE OF THE FEDERAL WATER POLLUTION CONTROL ADMINISTRATION IN FARM ANIMAL WASTE AND THE BY-PRODUCT MANAGEMENT,
Federal Water Pollution Control Administration, Chicago, Ill. Great Lakes Region.
Frank E. Hall.
In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, p 92-95, November 6-7, 1969.

Descriptors: *Farm wastes, *Water pollution, Research and development, Federal government, Disposal, Grants, Water pollution control, Lake Erie, Water quality, Standards, Legislation.
Identifiers: *FWPCA, Animal waste disposal, Agricultural practices, Feedlots, Enforcement actions, Water quality standards.

A discussion is presented stating how the programs of the Federal Water Pollution Control Administration relate to farm animal wastes and by-product managemeht. Examples are given of government and in-house research activities. Mention is given of those FWPCA supported activities that relate directly to the control of pollution from farm animals. These include pollution surveillance and water quality monitoring among others. The author feels that the most significant recent accomplishment in water pollution control is the establishment of water quality standards. (White-Iowa State)

0531 - A3, B1
TECHNICAL ASSISTANCE AVAILABLE FROM THE SOIL CONSERVATION SERVICE,
Soil Conservation Service, Madison, Wis.
Jack Densmore.
In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, p 96-97, November 6-7, 1969.

Descriptors: *Farm wastes, *Soil conservation, Surface runoff, Diversion, Grassed waterways, Terracing, Waste storage.
Identifiers: *Technical assistance, Soil Conservation Service, Farm waste disposal, Feedlot.

Situations in which technical assistance from the Soil Conservation Service (SCS) might be useful for reducing pollution from farm wastes are listed. Although the list is not all inclusive it gives an idea of assistance that can be obtained. An inventory and analysis of existing and potential areas where farm waste disposal may be a problem is needed. Technical assistance is available from the SCS to help on farm waste disposal problems, under the following limitations: (1) where the solutions involve techniques of soil and water conservation, (2) with the priorities established from time to time by local soil and water conservation district supervisors, and, (3) within the limitations of available man-power. (White-Iowa State)

0532 - B1, F1
COST-SHARING UNDER THE AGRICULTURAL CONSERVATION PROGRAM,
Agricultural Stabilization and Conservation Service, Madison, Wis.
Kenneth H. Hoover.
In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, p 98-100, November 6-7, 1969.

Descriptors: *Farm wastes, *Cost sharing, Pollution abatement, Soil conservation, Water conservation, Sedimentation.
Identifiers: ASCS, *Agriculture Conservation Program.

Practices and objectives of the Agricultural Conservation Program (ACP) have been broadened to include pollution abatement, provided such practices also result in soil and/or water conservation. The Agricultural Stabilization and Conservation Service (ASCS) manages program funds of the ACP. A list of components that ought to be included in pollution abatement cost-sharing practices is given. Most practices receive cost-sharing at 80% of cost. Farmer acceptance and financial contribution are needed to accomplish the stated objectives. (White-Iowa State)

0533 - F2
THE REGULATORY ROLE OF THE DEPARTMENT OF NATURAL RESOURCES,
Wisconsin Dept. of Natural Resources, Madison. Div. of Environmental Protection.
Thomas G. Frangos.
In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, p 101-104, November 6-7, 1969.

Descriptors: *Farm wastes, *Legislation, Water pollution, Pollution abatement, Wisconsin, Water quality, Regulation, Industrial wastes.
Identifiers: *Department of Natural Resources, Feedlots.

Statutes which point out the authority for Wisconsin water pollution abatement are cited. Other statutes are aimed at prevention and enforcement of sporadic discharges into streams. Based on these statutes, it is clear that the Wisconsin Department of Natural Resources has adequate authority to implement a program of pollution abatement aimed at any source of pollution. Difficulties in implementation include tradition, procedures, and lack of staff and funds. Any solution to the complex animal waste problem will involve a mix of programs, combining regulation, research, education, financial assistance, voluntary actions by landowners and possibly even tolerance on the part of the non-farm population. (White-Iowa State)

0534 - A1, A3
COLUMBIA COUNTY PROGRAM,

Columbia County Office, Portage, Wis.
Joe Tuss
In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, p 105-107, November 6-7, 1969.

Descriptors: *Farm wastes, *Nitrates, Water pollution, Air pollution, Odor, Pollution abatement, Zoning, Wells, Wisconsin.
Identifiers: Feedlots, Livestock concentration.

The Columbia County Extension Service was charged with formulating a 15 man farmer committee to study the present situation in view of pending proposed requirements of animal and agricultural waste disposal. It will make recommendations for preventing agricultural pollution in current problem areas and in expanding agricultural enterprises. A joint program by Columbia County Health Services, Zoning Administration and the University Extension formulated a project to sample well water for nitrates. Over 800 wells have been sampled. Forty-three percent of the high nitrate problem is on farms with high concentration of livestock. The public's demand for clean air, water and environment can be met by programs which involve the items of concern mentioned as well as others. (White-Iowa State)

0535 - A3

WHAT ARE THE PROBLEMS IN WALWORTH COUNTY,
Walworth County Zoning and Sanitation Office, Elkhorn, Wis.
James Johnson
In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, p 108-110, November 6-7, 1969.

Descriptors: *Farm wastes, *Water pollution, *Zoning, Pollution abatement, Eutrophication, Nutrients, Water resources, Land use, Lakes, Urbanization, Education, Erosion control, Land development, Regulation, Wisconsin.
Identifiers: Problem areas, Soil capabilities, Feedlots, Regional Plan.

Increased urbanization resulting in land use conflicts is the overall problem in Walworth County, Wisconsin. As a result, the water resources are deteriorating at an alarming rate. Eutrophication, erosion and nutrient pollution are the major causes. The Regional Plan, properly implemented will regulate growth in such a way as to prevent many problems before they occur. The Walworth County Sanitary Ordinance was a pioneering effort in pollution control which regulated urban growth through the use of soil surveys. The Ordinance will implement zoning by defining 'County Conservation Standards', which are all of the recommended conservation practices of the Soil Conservation Service. Much can be accomplished with local regulations, but education is essential to sell the program. (White-Iowa State)

0536 - F3

ROLE OF UNIVERSITY EXTENSION,
Wisconsin Univ., Madison. Div. of Economic and Environmental Development.
Gale Vandeberg
In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, p 111-113, November 6-7, 1969.

Descriptors: *Farm wastes, *Environment, Education, Universities, Research and development, Regulation, Water pollution, Wisconsin.
Identifiers: *University Extension, Adult education.

The challenge to Extension lies in the broad and continuous education of the public so that a pleasing and healthful environment may be maintained. The University Extension combined with the technical, financial and regulatory resources of other state and federal agencies has the resources to reduce the animal waste management problem. The University Extension staff has the responsibility to help various groups and the public to understand the problems and the alternatives, to help people who need to organize for action to do so, and to help groups and individuals to know what they can do, how to do it, and what resources are at their disposal. (White- Iowa)

0537 - F4

WHERE DO WE GO FROM HERE,
Wisconsin Univ., Madison. Dept. of Meat and Animal Science.
Richard H. Vilstrup
In: Proceedings of Farm Animal Waste and By-Product Management Conference, University Extension, University of Wisconsin, p 114-115, November 6-7, 1969.

Descriptors: *Farm wastes, *Environment, Wisconsin, Technology, Education, Research and development, Regulation, Legislation.
Identifiers: Waste management, Waste utilization.

The author attempts to briefly summarize the ideas and presentations made at the conference. He points out that the waste management problem has many dimensions, including environmental, social, economic, physical, political and psychological. There is an increasing concern for the quality of environment in Wisconsin. As such, research and education are needed in many areas. Five specific recommendations for continued emphasis in the waste management area are made. Recommendations are also made for educational development. (White-Iowa State)

0538 - A2, B1, C1, C5, E1

CHARACTERISTICS OF WASTES FROM SOUTHWESTERN CATTLE FEEDLOTS,
Texas Tech Univ., Lubbock. Water Resources Center.
Environmental Protection Agency, Water Pollution Control Research Series, January 1971. 87 p, 23 fig, 23 tab, 72 ref, 1 append. EPA Program 13040 DEM 01/71.

Descriptors: *Runoff, *Livestock, Quality control, Analysis, Cattle, Confinement pens, Feed lots, *Farm wastes, Southwest U.S., *Agricultural runoff, Solid wastes, Irrigation, Texas, Water reuse.
Identifiers: *Quality of runoff, *Lubbock (Tex).

Research was conducted on experimental feedlots in Lubbock, Texas, to determine the characteristics of wastes from Southwestern cattle feedlots. The feedlots were generally operated in a manner conforming to normal commercial practice in the area. They were provided with collection pits that allowed the quantity of runoff to be measured accurately. Samples of runoff were collected routinely both during rainstorms and from the collection pits. Manure samples were also collected routinely for analysis. The quantity of runoff per unit area of concrete-surfaced lots is substantially greater than the quantity per unit area of dirt-surfaced lots. Concentrations of pollutants in concrete-lot runoff are substantially higher than corresponding concentrations in runoff from dirt-surfaced lots. The quantity of solid waste derived from cattle fed an all-concentrate ration is less than half as great as the quantity derived from cattle fed a 12 percent roughage ration. Additional studies showed that all solid waste derived from cattle feeding operations are readily compostible, although the rate of composting is influenced to some extent by the type of ration, moisture content of the waste on the feedlot floor, and other factors. Agronomic studies indicate that runoff can be used for irrigation of crops, but extreme caution is required in the application of runoff to crops to prevent damage to them. (Dorland-Iowa State)

0539 - A2, B1, F2

PROCEEDINGS OF ANIMAL WASTE MANAGEMENT CONFERENCE,
Federal Water Pollution Control Administration, Kansas City, Mo.

Kansas City, Department of the Interior, February 1969. 40 p.

Descriptors: *Farm wastes, *Cattle, *Water pollution control.
Identifiers: *Feedlot pollution control, *State status reports, Animal production, Model feedlot regulation, Animal waste management.

An objective of the conference was to review the problem, as it exists today, of animal waste management. Information was given on how to conduct a state inventory of feedlots. A report was given on the Kansas animal waste control program. Control devices for animal feedlot runoff were discussed. The results of some feedlot pollution control research in Colorado and Nebraska was given. Status reports of 9 state pollution control programs were given, as well as model feedlot regulation design. (White-Iowa State)

0540 - F4

INDUSTRY AND THE ENVIRONMENT FEEDLOT WASTE MANAGEMENT,
Texas State Legislature, Austin.
W. Clayton
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, February, 1969. p 5-7.

Descriptors: *Farm wastes, *Cattle, *Regulation, Pollution abatement, Ecosystems, Waste disposal, *Feed lots.

In assessing the significance of the various threats to our water and air resources, two items should be kept in mind: (1) no one can come to the environmental table with clean hands, and (2) a disproportionate emphasis placed on one segment of the problem may result in other areas going unnoticed. Animal waste in general and feedlot waste in particular pose significant environmental problems in the areas of (1) fish and other aquatic life and recreational uses, (2) potable water supplies and (3) land usage and esthetics. These environmental challenges can best be overcome by means of an effective and active alliance between the feeding industry and the responsible regulatory agency. (Schmitt-Iowa State)

0541 - F4

FEEDLOT POLLUTION SLIDE SHOW,
Federal Water Pollution Control Administration, Kansas City, Mo. Missouri Basin Region.
R. S. Jessee
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, February 1969. p 7-8.

Descriptors: *Farm wastes, *Runoff, *Fish-kill, Irrigation, Farm lagoons, Odor, Cattle, *Feed lots, Water pollution sources, Water pollution control, Iowa, Nebraska, Missouri River Basin.
Identifiers: Flies.

A major source of pollution in the Missouri Basin is agricultural waste from feedlots. There are over 46,000 feedlots in Iowa and over 24,000 in Nebraska. Over 4 million cattle were on feed last year in Iowa. The wastes generated by 100 cows are equivalent to 8 to 18 hundred people. Feedlot pollution too often occurs as a slug load washed into the stream after moderate or heavy rains.

Twenty-eight slides show extreme examples of water pollution from feedlots. They include slides taken at the John Redmond Reservoir, where over a half million fish were killed from cattle runoff. Several slides of manure in feedlots depict conditions before and after heavy rains. Also shown is a feedlot with a diversion terrace, a large lagoon, a secondary lagoon, and cropland irrigation; thus the nutrient cycle is completed.
(Schmitt-Iowa State)

0542 - F4
ANIMAL WASTE POLLUTION - OVERVIEW OF THE PROBLEM,
Federal Water Pollution Control Administration, Kansas City, Mo. Missouri Basin Region.
J. M. Rademacher.
In: Proceedings of Animal Waste Management Conferences, Kansas City, Missouri, February 1969. p 7-9, 4 ref.

Descriptors: *Farm wastes, *Groundwater, Cattle, Fish kill, Animal population, Runoff, Confinement pens, Waste treatment, Wells, *Feed lots, Missouri River Basin, Water pollution sources.
Identifiers: Population equivalents.

The volume of animal wastes produced in the United States is about ten times that produced by the human population. Two billion tons of livestock wastes are produced annually in the U.S.A. This amount of waste production is equivalent to that of a human population of 1.9 billion. There is evidence that animal wastes are a major source of water quality degradation. Feedlot runoff contaminates water supplies, destroys fish and aquatic life in streams, and generally degrades water quality. These wastes also have an effect on ground water, of 6000 water samples analyzed in Missouri, forty-two percent contained more than 5 parts per million nitrate as nitrogen. Public recognition and open discussions constitute a major step toward the solution to this major problem.
(Dorland-Iowa State)

0543 - F3
INDUSTRY'S ROLE IN FEEDLOT POLLUTION CONTROL,
C. B. Joseph.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, February 1969. p 9-10.

Descriptors: *Farm wastes, *Cattle, *Waste disposal, Runoff, Groundwater, Animal populations, Kansas, Economics, *Feed lots, Water pollution control, Water pollution sources, Industrial wastes.
Identifiers: Industrial expansion, Beef consumption.

In Kansas cattle in feedlots with over 1000-head capacity have increased in excess of 700% and are producing over half the state's total beef production. In 1956, of the 182,000 head produced, only 30,000 head were produced in commercial feedlots with a capacity in excess of 1000 head; however, by 1969, the total production had risen to 766,000 head of which 486,000 were produced in feedlots with over 1000-head capacity. With this rapid increase in both the size and number of large feedlots, the problems of pollution control have become more pressing. Sites for new feedlots must be chosen more carefully with respect to terrain features and tax write-off incentives need to be extended to feedlot owners to cover the cost of adequate control and disposal facilities.
(Dorland-Iowa State)

0544 - F1, F3
HOW TO CONDUCT A STATE INVENTORY,
Minnesota Pollution Control Agency, Minneapolis.
J. P. Badalich.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, February 1969. p 11-12.

Descriptors: *Farm wastes, *Cattle, *Investigations, Runoff, Legislation, Minnesota, Waste disposal, Confinement pens, Financing, Permits, Topography, *Feed lots.
Identifiers: Inventory, Questionnaires.

The most important aspect of any feedlot inventory is the financing necessary to undertake such a project. Every government agency and private association is under a limited budget and the object of any study must be justified. Minnesota has 19,900 feedlots which makes personal investigations impractical and necessitate a canvas by mail. Some preliminary screening can be done by questionnaire which could be sent to households in rural areas. These questionnaires would not be applications for a permit, but would supply information on whether investigation for a permit would be necessary. These questionnaires would primarily determine the size of the operation, its location and topographical features, and the type of waste handling and disposal systems. Investigators could be sent where it was necessary and determine conformity to regulations and permits issued.
(Dorland-Iowa State)

0545 - F2
HOW TO CONDUCT A STATE INVENTORY,
Colorado Dept. of Health, Denver. Water Pollution Control Commission.
F. J. Rozich.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, February 1969. p 12-14.

Descriptors: *Farm wastes, *Cattle, *Investigations, Runoff, Legislation, Colorado, Waste disposal, Confinement pens, Financing, *Feed lots.
Identifiers: Inventory.

With the passage of the Colorado Water Quality Act of 1966, the Colorado State Agency gained jurisdiction over wastes discharged by feedlots in the state. The first task was gathering more specific information, such as ownership, acreage involved in the various feedlots, the number of animals fed, and the location of the facility. To carry out the inventory an engineering technician was employed for field surveys. The Milk, Food, and Drug Section and local health units were asked to complete a similar inventory as part of their routine inspections of dairy cattle facilities. Where a possibility of water pollution was indicated, district engineers were asked to follow up and discuss this matter with the owner of the facility.
(Dorland-Iowa State)

0546 - F2
THE KANSAS ANIMAL WASTE CONTROL PROGRAM,
Kansas State Dept. of Health, Topeka. Environmental Health Services.
J. L. Mayes.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, February 1969. p 15-17, 1 append.

Descriptors: *Farm wastes, *Legislation, *Water quality control, Cattle, Investigations, Runoff, Kansas, Waste disposal, Permits, Fish kill, Odor, Retention, *Feed lots, Water pollution control.
Identifiers: Flies, Slug flow.

With the increasing size and number of cattle feedlots, the public has been aroused on the problems of odor and fly production. This concern was brought to the attention of the Kansas Department of Health where the concern shifted to water quality in 1959 when fish kills began occurring downstream from a few feedlots. Field investigation of water pollution episodes revealed that the 'slug' flow of animal waste runoff can seriously pollute receiving streams. These investigations allowed the design of a control program which will yield significant results. These regulations require containment and control by irrigation practices of all runoff from animal feedlot installations, with the minimum retention of three inches of surface runoff. A copy of these regulations is included.
(Dorland-Iowa State)

0547 - A3, B1, D1
CONTROL DEVICES FOR ANIMAL FEEDLOT RUNOFF,
Nebraska State Dept. of Health, Lincoln. Water Pollution Control Council.
T. O'Brien, and T. A. Filipi.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, February 1969. p 18-19, 1 fig, 1 ref.

Descriptors: *Farm wastes, *Waste treatment, Confinement pens, Cattle, Aerobic treatment, Runoff, Farm lagoons, Irrigation, Waste disposal, Waste storage, *Waste water treatment, *Feed lots.
Identifiers: Anaerobic lagoons, Detention ponds.

The confinement feeding of livestock animals in large numbers has produced one of the most perplexing and complex problems ever faced by engineers, planners, and developers, not to mention the livestock feeder himself. The problem includes solid waste disposal, stream pollution, and air pollution. Basically, it involves the controlling of wastes from the animals in the confined feeding operations. Several types of control facilities are possible, detention ponds, anaerobic lagoons, aerobic lagoons, and oxidation ditches. A detention pond is intended to hold surface runoff from the feeding area and has the disadvantage of collecting large amounts of water which must be disposed of within a few days. Anaerobic lagoons work best when wastes are added at a constant rate which is difficult to maintain in a cattle feedlot. An aerobic system appears to be the most satisfactory with wastes scraped into hydraulically flushing gutters and emptied into variable aeration lagoons for treatment. (Dorland-Iowa State)

0548 - A1, F4
RESEARCH ON ABATEMENT OF POLLUTION AND MANAGEMENT OF ORGANIC WASTES FROM CATTLE FEEDLOTS IN NORTHEASTERN COLORADO AND EASTERN NEBRASKA,
Agricultural Research Service, Fort Collins, Colo. Soil and Water Conservation Research Div.
C. E. Evans.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, p 20-22, February 1969. 5 ref.

Descriptors: *Farm wastes, *Cattle, *Nitrates, Biochemical oxygen demand, Confinement pens, Runoff, Coliforms, Ammonia, Odor, Absorption, *Groundwater contamination, Water pollution sources, *Pollution abatement, *Organic wastes.
Identifiers: *Feed lots.

Livestock in the United States produce over 1 billion cubic yards of wastes per year. About three-fourths of our beef cattle are finished in feedlots. Some of these feedlots carry as many as 50,000 head, which presents a waste disposal problem similar to a city of 600,000 people. Rains are very efficient at picking up this material from feedlots, resulting in introduction of material with a high BOD into streams. Research was conducted to determine ground water pollution. Feedlots had the highest nitrate levels, but irrigated land probably contributes more total nitrate due to much larger acreage in irrigated land. There was a rapid die-off of the coliform population in feedlot soils, indicating little danger of ground water contamination by coliforms. Ammonia losses in the air result in odor and increased ammonia absorption by water surfaces around the feedlot. (Dorland-Iowa State)

0549 - F4

THE UNIVERSITIES' ROLE IN FEEDLOT POLLUTION CONTROL,
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
J. R. Miner.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, p 23-24, February 1969.

Descriptors: *Farm wastes, *Runoff, *Universities, Confinement pens, Cattle, *Pollution abatement, Research and development, *Feed lots.

Until feedlot runoff control is achieved in a manner acceptable to the livestock producer, regulatory agencies and the general public, the universities must play an active role. One of the principal contributions of universities toward solving the feedlot pollution problem is to guide and stimulate students through specific courses in livestock wastes combined with the basic principles of other scientific disciplines, such as civil and agricultural engineering, microbiology, chemistry, agronomy, and others. Extension education can be one effective method of alerting feedlot operators to the problems of feedlot runoff and bringing to them the currently available means of controlling or abating these problems. It also allows for feedback from feedlot operators to the university. A well-designed research project should, (1) be of interest to one or more researcher, (2) be compatible with available facilities, (3) stimulate growth on the part of the scientist and allow him to provide training to students, and (4) have some source of funding available. The roles of research centers and student training centers have been mutually beneficial. A university can interact with society through consultation of its staff with various individuals and agencies. Such interactions are possible because of the universities' reputation as an unbiased source of objective recommendations. (Schmitt-Iowa State)

0550 - F3

HOW TO GAIN PUBLIC SUPPORT,
Kansas City Star, Mo.
R. Turnbull.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, p 24-25, February, 1969.

Descriptors: *Farm wastes, *Runoff, Pollution abatement, Cattle, *Feed lots.

On the pollution subject there are two extremes, one group would stop doing anything that might in any way pollute streams, such as use of commercial fertilizer; while the other extreme insists they will continue to do as they please. Between these extremes are those people, both cattlemen and the general public, who will be reasonable if they are given the facts. The facts in the situation of feedlot runoff pollution consist mainly of numbers. Although not so at one time, we now have so many cattle and other livestock in feedlots that we have a problem. We must realize the number of cattle on feed has doubled since 1950. These numbers as simply as anything define the problem, and are understandable to the public. When they do understand this, they will be better prepared to give public support for whatever is needed to solve the problem. (Schmitt-Iowa State)

0551 - F2, F3

MINNESOTA FEEDLOT POLLUTION CONTROL PROGRAM – STATUS REPORT,
Minnesota Pollution Control Agency, Minneapolis.
J. P. Badalich.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, p 25-26, February 1969.

Descriptors: *Farm wastes, *Legislation, Administrative agencies, Legal aspects, *Regulation, *Minnesota, *Feed lots.

Following the Big Stone Lake study, a joint venture by the Governors of Minnesota and South Dakota, interest was generated in regulations regarding feedlot controls for the state as a whole. The Minnesota Pollution Control Agency is charged under statute for the control of all wastes. A 'preliminary draft' of regulations was published which caused criticism from many feeders and various organizations. These reports and comments should precipitate regulations that will be reasonable and desirable. We then go through the statutory procedure of public hearings, where we hope to get the reactions of the people in industry as well as the public at large. The next step is for the assistant attorney general to come up with the findings of fact, conclusions, and order. The Agency will then promulgate the standards, have them published, and issued. Following this we will set up specific rules, regulations and procedures, and then go into an inventory type procedure. Any regulation or standard proposed to the public or any industrial or municipal group must be reasonable, feasible, and practicable. (Schmitt-Iowa State)

0552 - F2, F3

STATUS, PLANS, AND NEEDS FOR A COMPREHENSIVE FEEDLOT POLLUTION CONTROL PROGRAM IN SOUTH DAKOTA,
South Dakota State Dept. of Health, Pierre. Water Pollution Control Section.
B. Barker.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, p 26, February, 1969.

Descriptors: *Farm wastes, *Regulation, *Administrative agencies, *South Dakota, Legislation, Pollution abatement, *Feed lots.

A provision for promulgation of regulations to control wastes associated with confined feeding of livestock was included in the Plan of Implementation of the 'Water Quality Standards for the Surface Waters of South Dakota.' The standards were adopted by the South Dakota Committee on Water Pollution on April 20, 1967 and by the Secretary of the U.S. Dept. of the Interior on August 7, 1967. In January, 1967, an Advisory Committee on the Committee on Water Pollution and the State Department of Health was formed to provide technical assistance in developing regulations. Proposed regulations were discussed at a public meeting in Pierre on December 9, 1968. The Committee on Water Pollution will review feedlot waste disposal information presented at the December meeting and will prepare a regulation for the purpose of holding public hearings. We are working with the South Dakota Water Resources Institute and Civil Engineering staff at South Dakota State University in developing a study on the effects of feedlot wastes on our surface waters. Plans include an education program to keep the industry informed of proposals and obtain feedback from the agricultural community. (Schmitt- Iowa State)

0553 - F3

STATUS REPORT OF MONTANA'S PROGRAM TO CONTROL POLLUTION FROM ANIMAL FEEDLOTS,
Montana State Dept. of Health, Helena. Water Pollution Control Section.
D. Willems.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, p 27, February, 1969.

Descriptors: *Farm wastes, *Regulations, *Montana, Administrative agencies, Legislation, Pollution abatement, *Feed lots.

Montana does not have feedlot regulations but at this time is developing regulations. Most complaints on feedlots are because of nuisance conditions, thus, control of both air pollution and water pollution seems essential. Development of a permit system for feedlots, similar to the present system for municipal and industrial waste discharges is hoped for. The main concern at this time is to have adequate control of new feedlots and the prediction is that there will be many in the state before too long. It looks as though much time could be spent on controls for existing feedlots with very little accomplishment. (Schmitt-Iowa State)

0554 - F3

MISSOURI'S ANIMAL WASTE MANAGEMENT,
Missouri Water Pollution Board, Jefferson City.
B. Crockett.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, p 27, February 1969.

Descriptors: *Farm wastes, *Regulation, *Missouri, Administrative agencies, Waste disposal, Pollution abatement, Cattle.

The Missouri Water Pollution Board believes the agricultural pollution in Missouri can be controlled through a program of education at this time. The Board is cooperating with the University of Missouri Extension Service and the Federal and State Departments of Agriculture to educate the farming public for the control of agricultural pollution. In May, 1968, the University of Missouri Extension Service completed a revised agricultural inventory for the Board on the stream basins of Missouri. This study, to be updated every three years, includes land use data, fertilizer and pesticide usage data, as well as animal and poultry production data for each basin. The Missouri Water Pollution Board does not plan to request legislation pertaining to the registration of feeders and, and/or confiners at this time. (Schmitt- Iowa State)

0555 - F4

STATUS REPORT - KANSAS FEEDLOT POLLUTION CONTROL PROGRAM - EXTEMPORANEOUS REMARKS,
Kansas State Dept. of Health, Topeka. Environmental Health Services.
M. W. Gray.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, p 28, February, 1969.

Descriptors: *Farm wastes, *Regulation, *Kansas, Administrative agencies, Fertilization, Cattle, *Feed lots, Waste disposal.

As a result of research undertaken approximately five years ago at Kansas State University and the University of Kansas, it was concluded that the activated sludge type of treatment of wastes from animal feedlot operations is not feasible from an economic standpoint. Retention ponds and the use of retained wastes for agricultural purposes was the key to our solution in Kansas. Although final authority for pollution control rests with the Department of Health, our problems are approached with the livestock sanitary commissioner's office, the agricultural extension service, the county agent, the consulting engineer, and the feeder. We are not seriously concerned from the standpoint of ground water pollution by way of the feedlot surface or from retention facilities. We are more concerned with the solid waste material, the manures that are cleaned from the feedlot surface and reapplied to agricultural land. The amount of nutrients that can be applied per acre is directly proportional to that which will be removed with the crop grown. We strive for cooperation and understanding from the animal feeding community, as this is essential to our program. (Schmitt- Iowa State)

0556 - F2, F3

STATUS REPORT - NEBRASKA FEEDLOT POLLUTION CONTROL PROGRAM,
Nebraska Water Pollution Control Council, Lincoln.
T. A. Filipi.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, p 29, February, 1969.

Descriptors: *Farm wastes, *Regulation, *Nebraska, Fertilization, Administrative agencies, Runoff, Cattle, *Feed lots.

Water Quality Standards have been adopted and are well-known to all persons in the state of Nebraska. Municipalities and industries have taken care of their responsibilities and other polluters must follow in the program. The problem of pollution from the industry of agriculture, specifically feedlots, was brought to the attention of the Nebraska Water Pollution Control Council by persons living downstream from the feedlots. They brought in evidence such as samples of water and photographs which clearly convinced the Council that serious pollution does occur and corrective steps must be taken. A Feedlot Operators Committee was formed and assigned to prepare rules and regulations relating to the registration of feedlots. A voluntary survey regarding the size and location of feedlots received better than 80% compliance. The next assignment of the committee is development of solutions within the economic possibility of the industry. Research is carried on by the University of Nebraska Extension Division working with the United States Dept. of Agriculture. The greatest problem that confronts Nebraska Water Pollution Control Council is that of answering questions of persons intending to set up feedlot operations, since we have no guidelines for Nebraska conditions. (Schmitt-Iowa State)

0557 - F3

STATUS OF NORTH DAKOTA'S PROGRAM TO CONTROL POLLUTION FROM ANIMAL FEEDLOTS,
North Dakota State Dept. of Health, Bismarck. Div. of Water Supply and Pollution Control.
N. L. Peterson.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, p 30, February, 1969.

Descriptors: *Farm wastes, *Regulations, *Administrative agencies, *North Dakota, Runoff, Cattle, *Feed lots.

Shortly after the state's new Water Pollution Control Board took office on July 1, 1967, they requested the State Department of Health to present to them as much information as possible on pollution from agricultural areas and, if possible, draft a proposed preliminary set of rules and regulations. The first draft was presented in October, 1967 and used Kansas proposed regulations as a guideline. An Advisory Committee on Feedlot Wastes was then established. It was composed of Health Department personnel, representatives of the Board, and representatives of the various cattle raising and feedlot operators associations. This Committee was to review and comment on proposed regulations, discuss them with their constituents, obtain comments, and recommend changes. The Advisory Committee failed to obtain many comments on the third draft of the proposed rules and regulations and decided to withhold any further action until a report on the Animal Waste Management Conference in Kansas City on February 20, 1969 could be obtained. Due to the number of variable factors involved in feedlot operation, the actual extent of pollution is difficult to establish. Thus, there is a need for much additional research into the problem of feedlot pollution. Ultimately, rules and regulations will probably be adopted. (Schmitt-Iowa State)

0558 - F3

COLORADO'S STATEMENT, STATUS, PLANS, AND NEEDS FOR A COMPREHENSIVE FEEDLOT POLLUTION CONTROL PROGRAM,
Colorado State Dept. of Public Health, Denver. Pollution Control Div.
F. J. Rozich.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, p 30-31, February 1969.

Descriptors: *Farm wastes, *Regulations, *Colorado, Cattle, Legislation, Administrative agencies, Runoff, *Feed lots.

The extent of the problem of pollution attributable to feedlot wastes is being determined not only by the inventory being conducted, but also through stream studies. After public hearings and much discussion pro and con, the Colorado Water Pollution Control Commission adopted 'Rules for the Control of Water Pollution from Livestock Confinement Facilities' on April 10, 1968. Where it is determined, through field inventory and subsequent inspections, that a pollution problem does or can exist, the feeder will be asked to comply with the adopted rules. A Cease and Desist Order will be issued and an injunction sought if the feedlot operator fails to comply within a reasonable time. All types of animals corralled or tethered, including recreational horses, are included in the rules. The pace of advancement of a pollution control program is governed largely by the amount of monies and personnel available for such a project. (Schmitt-Iowa State)

0559 - F3

FEEDLOT POLLUTION CONTROL IN IOWA,
Iowa State Dept. of Health, Des Moines. Environmental Engineering Service.
R. J. Schliekelman.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, p 31-32, February, 1969.

Descriptors: *Farm wastes, *Regulation, *Iowa, Cattle, Legislation, Administrative agencies, Runoff, *Feed lots, Water pollution control.

A study committee comprised of three Iowa Water Pollution Control Commission members, two agricultural engineers and the extension veterinarian from Iowa State University was formed in November, 1966 to study the feedlot waste problem and make recommendations for corrective measures. During 1967 a permanent Agricultural Advisory Committee was appointed by the WATER Pollution Control Commission to formulate tentative criteria for a permit system and tentative standards for design of feedlot runoff control systems. Four public hearings were held in April, 1968 as a part of the procedure for establishing regulations. The 'Proposed Cattle Feedlot Waste Water Disposal Regulations' defined a feedlot and described conditions under which a permit for waste disposal is required. Accompanying tentative 'Requirements for Water Pollution Control Facilities' described satisfactory facilities for handling the feedlot runoff waste. The rules and regulations were adopted by the Commission in 1968 and referred to the Legislative Departmental Rules Review Committee for final approval. Objections were voiced and the rules were disapproved. The Committee did recommend and volunteered assistance in sponsoring legislation to permit a registration procedure. Demonstration grants have been requested from the FWPCA to build model facilities, which it is felt, would do more to prevent pollution from feedlots than any other item not already undertaken. (Schmitt-Iowa State)

0560 - B1, F4

ANIMAL WASTE MANAGEMENT QUESTIONS AND ANSWERS,
Federal Water Pollution Control Administration, Kansas City, Mo. Missouri Basin Region.
A. V. Resnik.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, p 33-34, February, 1969.

Descriptors: *Farm wastes, *Runoff, *Confinement pens, Regulation, Water pollution control.

In the initial phase of confinement livestock feeding, feedlots were, by design, situated where the rains would scour the waste materials from the lots, preferably into nearby draws and streams. We know now that the highly concentrated organic waste cannot and must not be discharged without treatment into streams. The exact contribution and the total effect of animal wastes on the water quality of the Missouri River Basin is not known. Prevention and control cannot wait while all the data are collected and assembled. Feedlot runoff pollution could be greatly reduced with a minimum expenditure by utilizing known information. Regulations are necessary to insure the feedlot operator that the measure he is taking will guarantee a reasonable tenure of operation. Uniformity which concurrently allows for flexibility must be built into the regulations, since there is no one model or control device that will substantially alleviate animal waste pollution. Possible control methods include, (1) zoning of entire watersheds for livestock production, (2) government built 'first generation' plants of new concept and design, (3) development of supplemental range feeding programs, and (4) composting a mixture of manure and municipal garbage for use on a 'greenbelt' separating the city from the animals.
(Iowa State)

0561 - F3

INVENTORY AND ASSESSMENT OF THE PROBLEM OF POLLUTION FROM FEEDLOT WASTES,
North Dakota State Dept. of Health, Bismarck. Div. of Water Supply and Pollution Control.
N. L. Peterson.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, p 34-35, February, 1969.

Descriptors: *Farm wastes, *Runoff, Confinement pens, Cattle, Pollution abatement, Regulations, *Feed lots.

Feedlot wastes differ from municipal and industrial wastes in that they are not confined nor do they have predictable flows. The wastes from feedlots generally reach the stream only during periods of runoff. The first step toward assessment of the pollution problem might be to determine areas of the state where most feedlots are concentrated and what major or minor river basins have the highest potential of being polluted at times of feedlot runoff. The next step might be to develop an inventory of feedlots including data on location, topography, number of cattle, and other characteristics of the lot operation and management. Methods of obtaining inventory information might be through permits, County Extension Offices, farm associations, and perhaps through individual personal contact. A state water pollution control agency, adding pertinent weather data to this information, should be in a position to access the pollution potential, both individually and for each river basin. Certainly much can be accomplished if the state water pollution control agency makes a sin-

cere offer of assistance and advice to individual feedlot operators. Rules should be drawn up for the purpose of assisting the state agency and the feedlot operator to solve a mutual problem.
(Schmitt-Iowa State)

0562 - F3

ASSESSING THE PROBLEM OF FEEDLOT POLLUTION,
Missouri Univ., Columbia. Dept. of Agricultural Economics.
C. G. McNabb.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, p 35-36, February, 1969.

Descriptors: *Farm wastes, *Runoff, Confinement pens, Cattle, Pollution abatement, Legislation, *Feed lots.

Cattle feedlots have been receiving an increasing amount of attention from pollution conscious people because of their growing number and size, they can be seen and smelled, and our affluent society is becoming more concerned with esthetic values. Action is demanded and we must progress using the best information available while trying to secure additional data. A partial list of useful data might include (1) quantity and capacity, (2) number of impoundments to catch runoff, (3) how the solids and liquids are handled, (4) the slope and length of slope, and (5) the soil type. Eventually the data should help us determine what effect feedlots have on the water quality of a basin. One method of developing an inventory is to legislate a permit requirement. A more desirable method is to voluntarily work with livestock organizations to gather information and set guidelines for pollution abatement. However, at the present time much uncertainty exists on the type of pollution abatement facilities that are effective and feasible. An information-education program is needed to create an awareness of the pollution problem by the livestock people. Awareness should precipitate more cooperation with agencies involved as well as initiate voluntary abatement programs.
(Schmitt-Iowa State)

0563 - F2, F3

A RECOMMENDED PROCEDURE FOR DEVELOPING A MODEL FEEDLOT REGULATION,
South Dakota School of Mines and Technology, Rapid City.
F. L. Matthew.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, p 37-38, February, 1969.

Descriptors: *Farm wastes, *Runoff, *Regulation, Pollution abatement, Cattle, Legislation, Confinement pens, *Feed lots, *Model studies.

In the development of a feedlot regulation, other alternatives should first be considered and the need for a regulation firmly established. Next it is necessary to establish general and specific objectives for the proposed regulation. After establishing objectives, restraints should be considered. Budget and staff limitations will normally be the most important restraints on the implementation program. The last step is to establish evaluation criteria which should include: (1) preventive or corrective nature, (2) clear information about the feedlot operators obligations, (3) enforceability within staff budget restraints, (4) provisions for appeal, (5) avoidance of discrimination, (6) control of both new and existing facilities, (7) control of construction and operation, (8) provisions covering ultimate disposal of wastes, (9) provisions for periodic updating, (10) compatibility with existing Federal, state and local laws, (11) definitions of pollution and pollution parameters, and (12) establishment of effluent quality standards and specification of sampling procedures. When these steps have been taken and necessary public information programs are underway, the development of the feedlot regulation and implementation program plans can proceed. (Schmitt-Iowa State)

0564 - F4

RESEARCH NEEDS IN CATTLE FEEDLOT WASTE CONTROL,
Kansas State Univ., Manhattan. Dept. of Civil Engineering.
L. A. Schmid.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, p 38-39, February, 1969.

Descriptors: *Farm wastes, *Research and development, By-products, Pollution abatement, *Feed lots.

Although research priorities cannot be neatly separated since most of the categories are interrelated, certain areas should receive increased research emphasis. Characterization of wastes should be included in studies wherever possible. The sanitary engineer's fundamental knowledge of biological waste treatment and other processes is sufficient that he can design a process, biological or otherwise, based on a knowledge of the waste characteristics. Biological treatment in a liquid system of the manure scraped from a feedlot should not warrant a high degree of priority, since most of the biodegradable solids have already decomposed depending on the age of the manure and the conditions involved. Return to the land appears to be the most favored method of disposal. We know very little of the effect of the heavy loading anticipated from large feedlot operation, but somewhere there must be a balance between rate of waste disposal, land destruction, and crop production while satisfying the primary goal of pollution control of both surface and ground water. The next priority deals with either management practice or processes that reduce the solid or liquid waste that comes from the lot. Reuse of wastes as feed material and other by-product recovery schemes may require attention in the future. (Schmitt-Iowa State)

0565 - B1, F4

RESEARCH AND DEVELOPMENT VIEWS OF ANIMAL WASTE MANAGEMENT,
Federal Water Pollution Control Administration, Washington, D.C. Div. of Applied Science and Technology.
H. Bernard.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, p 40, February, 1969.

Descriptors: *Farm wastes, *Waste treatment, Cattle, Pollution abatement, Administrative agencies, Research and development, Water pollution control.

The problem of the waste from animal feeding must be considered not only as a pollution abatement problem, but rather as an animal feeding or an animal management problem in which waste management is considered as an integral part of the overall problem of making a profit from your investment. The prime consideration is to maximize profit taking into account the additional cost of waste management. This could even mean changing the feed to decrease the amount of wastes produced or the quality to make it easier to handle the waste products. The Office of Research and Development of the FWPCA is anxious to demonstrate new or improved techniques for handling and treating animal wastes that reduce the pollutional load to receiving streams or ground water. Participation with industry can include up to 70% of the total cost. The nation as a whole desires pollution abatement to become an integral part of our economy and expects a definite improvement in our environment. (Iowa State)

0566 - F3

DEVELOPING AN ANIMAL WASTE MANAGEMENT ACTION PROGRAM,
Missouri Univ., Columbia. Agricultural Extension Div.
S. H. Bodenhamer.
In: Proceedings of Animal Waste Management Conference, Kansas City, Missouri, p 40, February, 1969.

Descriptors: *Farm wastes, *Regulation, *Legislation, Pollution abatement, Water pollution control.

Many dynamic forces will affect the implementation of a desired animal waste management program. Before attempting to initiate change, any social system should (1) define the situation to be changed, (2) describe the desired situation, (3) list what needs to be done to accomplish the desired, and (4) describe the resources available and those that are needed. A listing of the different audiences or interest groups can be helpful in preparing a message for them. Each audience will need to see how the change will help them satisfy their own needs for goods, services, and attitudes. Decide on what method is to be used to reach each audience, as change is best brought about through good communications and cooperation. Methods may be influenced by the size of the audience and their state of adoption. Those to affect or be affected by animal waste management programs must be involved in deciding what should be the program. Cooperation is positively correlated with the degree of involvement the parties to be affected are involved in shaping the proposed action.
(Schmitt-Iowa State)

0567 - A9, C4

BACTERIAL AND FUNGAL FLORA OF SEAGULL DROPPINGS IN JERSEY,
Jersey General Hospital, St. Helier (England).
J. Cragg, and Y. M. Clayton.
Journal of Clinical Pathology, Vol 24, No 4, p 317-319, 1971. 12 ref.

Descriptors: *Animal wastes (Wildlife), *Bacteria, *Fungi, Waste identification, E. coli, Streptococcus, Yeasts, Salmonella, Shigella, Seashores, Sampling, Laboratory tests, Gulls.
Identifiers: *Seagull, Mycology, Jersey.

In Jersey 166 fresh and 122 dried seagull droppings were obtained and studied locally and in London for the presence of bacteria and fungi of potentially pathogenic nature. There were no salmonella or shigella bacteria isolated from the two groups but there was a high proportion of Candida albicans obtained from the fresh material (21.7%) and only 1.6% from the dry faeces. Cryptococcus neoformans and Histoplasma capsulatum were not found in either the dry or fresh droppings. The normal bacterial and fungal flora of the seagull was established and it is considered that the C. albicans in fresh gull droppings would not materially increase albicans infections in man. (Bundy-Iowa State)

0568 - B1, F5

DEAD BIRD DISPOSAL BY RENDERING,
California Univ., Riverside.
W. C. Fairbank, and E. L. Bramhall.
Poultry Digest, Vol 30, No 358, p 600-601, December 1971.

Descriptors: *Farm waste, *Chickens, *Waste disposal, *By-products, Artificial use.
Identifiers: Rendering.

The reduction of dead poultry, and poultry viscera, feathers, cockerels, and unmarketable eggs to salable by-products is probably the most nearly perfect disposal method for these wastes. Rendering is a recycling process. Meat, bone, and feather meal are used in formulation of livestock and pet foods. The rendered 'yellow grease' is used mainly by feed, soap, and chemical industries. Usually no payment is made to the poultry supplier, but receptacles with tight-fitting lids are supplied. Whole carcasses are cooked and fed uniformly to a tapered screw oil expeller or press. Dead whole poultry yield 50% recovery, 25% of which is grease and 75% meal. The value of meal (about 58% crude protein and 4% crude fats) is approximately four cents per pound. The value of feed grade yellow grease is about seven cents per pound. Restaurant grease, butcher shop trimmings, and small animals can be blended to provide sufficient volumes for continuous use of the rendering plant cookers. A layer population of several million hens is necessary to supply adequate mortalities if there is no other source of compatible waste. (Schmitt-Iowa State)

0569 - C3, D1, E1

ENZYMATIC EVALUATION OF PROCESSES FOR IMPROVING AGRICULTURAL WASTES FOR RUMINANT FEEDS,

Agricultural Research Service, Albany, Calif.
Jack Guggolz, R. M. Saunders, G. O. Kohler, and T. J. Klopfenstein.
Journal of Animal Science, Vol 33, No 1, p 167-170, July 1971. 4 fig, 1 tab, 14 ref.

Descriptors: *Farm waste, *Enzymes, *Biochemistry, *Digestion, *Biodegradation, *Ruminants, Cattle, Sheep, Degradation, Refuse, Cellulose, TDN, Alfalfa, Forages, Lignin.
Identifiers: *Onozuka SS, *Agricultural residues, Roughage, Hemicellulose, Reed canary grass, Smooth bromegrass, Tall Fescue.

Agricultural residue high in cellulose and hemicellulose are a potentially valuable source of energy to ruminant animals, but low digestibility of the carbohydrates make some type of chemical or physical modification necessary. A procedure has been developed enabling one to correlate 'in vivo' digestion of residues with 'in vitro' dry matter disappearance. The procedure involves digestion of the crop residue or forage with a crude cellulose enzyme followed by protease digestion. 'Onozuka' SS was found to be the most active cellulose and was added at a rate of 750 milligrams per gram of residue, and incubated at 40C for 72 hours. At the end of incubation a series of procedures was followed to separate and weigh the remaining residue. Onne hundred minus the percent residue was called 'total solubles after enzymes' (TSAE). The correlation coefficient between enzymatic and 'in vivo' results for alfalfa, reed canary grass, smooth bromegrass, and tall fescue were 0.997, 0.876, 0.998, and 0.999 respectively. The procedure appears to predict dry matter digestibility with sufficient precision to be of use to laboratories with no access to donor ruminant animals. (Schmitt-Iowa State)

0570 - A7, A8, C4

MANURE MITES AND THEIR ROLE IN FLY CONTROL,

Kentucky Univ., Lexington. Dept. of Entomology.
J. G. Rodriguez, Pritam, Singh, and Bob Taylor.
Journal of Medical Entomology, Vol 7, No 3, p 335-341, 1970. 2 fig, 4 tab, 30 ref. Public Health Service No CC 00207.

Descriptors: *Farm wastes, *Insect control, *Mites, Cattle, Poultry, Larvae, Oviposition, Insecticides, Diazinon, Insect eggs, *Waste treatment, Toxicity.
Identifiers: *Flies.

Glyptholaspis confusa (Foa) and Macrocheles muscaedomesticae (Scopoli) generally attain their highest populations in stock piles of cattle manure in the fall and early spring. Their food during the fly-free season consists mainly of nematodes. In poultry houses populations of M. muscaedomesticae start building up in manure in the summer. Fuscuropoda vegetans (DeGeer) attains high populations in early summer and continues to build up as the season progresses until late fall. Acarine control of the house fly in a poultry house under semi-field conditions ranged from 86 to 99%, depending in the mites involved. Fourteen chemicals were tested in the laboratory for toxicity to newly-hatched maggots of the house fly and the adult, M. muscaedomesticae. Diazinon, ronnel, Bayer 38156, malathion and dimethoate were relatively toxic to the house fly maggot and relatively non-toxic to the mite. Sugar-based baits were used against the adult flies in the integrated control program with promising results. (Parker-Iowa State)

0571 - A3, B1, E3

EFFECT OF METHOD OF MANURE HANDLING ON CROP YIELDS, NUTRIENT RECOVERY AND RUNOFF LOSSES,

Wisconsin Univ., Madison. Dept. of Agricultural Engineering; and Wisconsin Univ., Madison. Dept. of Soils.
R. R. Hensler, R. J. Olsen, S. A. Witzel, O. J. Attoe, and W. H. Paulson.
Transactions of the American Society of Agricultural Engineers, Vol 13, No 6, p 726-731, November-December 1970. 10 tab, 26 ref. OWRR-14-01-0001-858.

Descriptors: *Farm wastes, *Crop production, *Application methods, Runoff, Nutrients, Greenhouses, Waste disposal, Chemical analysis, Fertility, Soil chemical properties.
Identifiers: *Nutrient recovery, Anaerobic liquid manure, Aerobic liquid manure.

A study was made of the effect of type of manure, method of handling, amount of bedding, drying treatment, and rate of application on the fertilizing value of cattle manure for corn and hay and on runoff losses. Dairy and beef cattle manure was applied as fresh, fermented, aerobic liquid and anaerobic liquid, both in greenhouse conditions and in actual field tests. Tests were run to determine nutrient loss before application and nutrient recovery by plants and runoff losses after application. Results showed increased corn dry matter in all cases of manure application with poorer results shown by the aerobic liquid than the other three. Allowing manure to dry for one week before incorporation usually gave lower yields and lower recovery values for N, P, and K. Total dry-matter yields of corn were not greatly affected by increasing amounts of bedding up to 8 percent, but at the 16 percent rate, yields were usually much lower. (Parker-Iowa State)

0572 - A9, C4, E3, F2

AN ASSESSMENT OF SOME PUBLIC HEALTH PROBLEMS RESULTING FROM FEEDING POULTRY LITTER TO ANIMALS. MICROBIOLOGICAL AND CHEMICAL PARAMETERS,

Food and Drug Administration, Cincinnati, Ohio. Div. of Microbiology.
James W. Messer, Joseph Lovett, Gopala K. Murthy, Albert J. Wehby, and Mary L. Schafer.
Poultry Science, Vol 50, No 3, p 874-881, May 1971. 3 tab, 14 ref.

Descriptors: *Farm wastes, *Poultry, *Disposal, *Feeds, *Public health, Cattle, Hogs, Sheep, Pesticide residues, Microbiology, Health, Diseases, Salmonellae, Sewage, Bacteria, Arsenic compounds.
Identifiers: Food and Drug Administration, Medicinals, Ultraviolet-light-activated substances.

Feeding studies on the utilization of poultry litter as a feed additive for ruminants have demonstrated satisfactory animal nutrition, thus, opening many questions of public health significance. This study examined the heat resistance of salmonellae and Arizona pathogens; whether heat treatment of poultry litter would provide an effective barrier against disease transmission; and determined the levels of some medicinals, pesticides, and ultraviolet light activated compounds in poultry litter. Results showed that a heat process for the elimination of salmonellae and Arizona sp. may be feasible, since they are not highly resistant to heat. E. Coli being less resistant to moint heat than salmonellae, were eliminated as an indicator of the efficiency of the heating process. With the exception of arsenic, the concentration of pesticides and medicinals present in the litters assayed in this study were low. On the basis of the highest observed values in litter, beef cattle and dairy cattle fed 30% of their diet as litter would receive approximately 46.0 mg of arsenic, 19.0 milligrams of uric acid, 16.0 milligrams of nitrofurazone, 15.0 milligrams of furazolidone, and 1.4 milligrams of ultraviolet-activatable substances per day. The possibility of higher levels and the unknown effect of continuous exposure to low levels suggests the present ban on the interstate shipment of poultry litter for animal feed is warranted. (Schmitt-Iowa State)

0573 - A5, D2

METHODS OF REMOVING SETTLEABLE SOLIDS FROM OUTDOOR BEEF CATTLE FEEDLOT RUNOFF,

Nebraska Univ., Lincoln. Dept. of Agricultural Engineering.
C. B. Gilbertson, T. M. McCalla, J. R. Ellis, and W. R. Woods.
Transactions of American Society of Agricultural Engineering, Vol. 14, No. 5, September-October 1971. p 899-905, 19 fig, 2 tab, 11 ref.

Descriptors: *Farm wastes, Runoff, Cattle, *Settling basins, Waste disposal, *Feed lots, *Waste water treptment.
Identifiers: *Liquid storage, Continuous flow, Batch system, *Feedlot runoff.

Two experimental systems were installed to study removal of settleable solids from runoff. One method, termed the 'batch' system, consisted of a primary settling basin and a secondary basin. All runoff from a given storm event was trapped within the primary settling basin and detained to allow the heavier solids to settle to the bottom of the basin. The supernate was pumped from the primary basin into the secondary basin for longer detention times. The other concept was termed 'continuous flow.' Runoff resulting from a storm moved continuously through a series of porous dams. The porous dams reduced the velocity of flow sufficiently to allow the heavier particles to remain in the settling channel while the liquids flowed by gravity to a liquid storage pond. Results of the 1-1/2 year study are: (1) The concentration of chemicals and solids in runoff was highly variable for rainfall-runoff events; (2) Rainfall runoff transported about 1.6 tons of solids per acre-inch, while winter runoff transported about 10 tons per acre-inch; (3) The batch system removed settleable solids efficiently; however, the system maintenance had considerable disadvantages; (4) The continuous flow concept may be readily adapted to many of the feedlots experiencing runoff problems; (5) Settling of solids presents more of a problem during cold weather. (Bundy-Iowa State)

0574 - D4

OXIDATION DITCH IN A CONFINEMENT BEEF BUILDING,

Illinois Univ., Urbana. Dept. of Animal Science; and Illinois Univ., Urbana. Dept. of Agricultural Engineering.
D. D. Jones, D. L. Day, and U. S. Garrigus.
Transaction of the ASAE, Vol. 14, No. 5, Sept.-Oct 1971. p 825-827, 6 fig, 2 tab, 1 ref.

Descriptors: *Farm wastes, *Confinement pens, *Oxidation lagoons, Aerobic bacteria, Costs, Cat-

tle, *Waste water treatment, Biochemical oxygen demand, Chemical oxygen demand.
Identifiers: *Beef cattle wastes.

Disposing of beef cattle wastes with an in-the-building oxidation ditch is being studied by the Departments of Animal Science and Agricultural Engineering in an experimental beef-confinement facility at the University of Illinois Beef Farm. Waste from cattle consuming rations of high-roughage and high-concentrate was studied during a four month test period from March through June, 1969. Field trials indicated that the in-the-building oxidation ditch is a satisfactory method of treating beef cattle waste. Loading rates of 55 cm ft of oxidation ditch per 800 pound fattening calf and 80 cu ft per cow and calf were used. The 5-day mixed-liquor biochemical oxygen demand values were less than 1,000 mg per liter and the supernatant BOD5s were usually less than 200 mg per liter. The chemical oxygen demand values were extremely high (up to 55,000 mg per liter) due to the high cellulose ration fed to the first group of animals. There was some evidence that biological activity was influenced by cold climates. Assuming a daily BOD5 production of 1.3 pound per 1000 pound beef feeder and a power cost of 2 cents per KWH, the aeration rotor operating cost would be about 2.5 cents per 1,000 pound animal per day. This would be about 1 cent per pound of gain. (Schmitt-Iowa State)

0575 - A5, B1, D1, E1

POULTRY WASTE HANDLING SYSTEMS,
Cornell Univ., Ithaca, N. Y. Dept. of Poultry Science.
C. E. Ostrander.
Poultry Digest, November 1971, p 529-532.

Descriptors: *Farm waste, *Odors, Drying, Aerobic, Anaerobic, Poultry, Oxidation lagoons, Design, Effluents, Waste water disposal, Fertilizer, Hydraulic structures, Waste management.
Identifiers: Storage capacity, Plow-down application, Laying cages, Deep pits.

The problems of waste management have become increasingly important primarily because of increasing in flock size, concentration of birds and population migration to the country. There are several waste handling systems, none of which is adaptable to all situations. Some of the more popular types of waste handling systems are: (1) deep pits which are capable of handling at least 6 to 9 months storage, (2) hydraulic systems with aerated lagoon, and (3) oxidation ditches. Spreading of slurry taken from the storage pits also creates problems, if not handled properly. If liquid spreaders are used, the spreaders should be enclosed to reduce odors on public roads and on other property. In the spreading of manure by the use of plow-down application method, the material is poured into the furrow followed up by plowing. The soil being a very good filter, reduces the odors. Regardless of the practice followed in handling waste products, care should be taken to avoid a poor image in the community. (Bundy-Iowa State)

0576 - A5, A6, C3

CHEMICAL OXYGEN DEMAND OF GASEOUS AIR CONTAMINANTS,
Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.
J. D. Frus, T. E. Hazen, and J. R. Miner.
Transactions of the ASAE, Vol. 14, No. 5, 1971. p 837-840, 5 fig, 6 tab, 8 ref.

Descriptors: *Farm wastes, *Odors, *Chemical oxygen demand, Air pollution, Ammonia, Confinement pens, Analytical techniques, *Oxygen demand.
Identifiers: *Organic gases.

In an attempt to quantify the atmosphere of a confinement swine building according to odors, the chemical oxygen demand analysis was modified and used to analyze the atmosphere within the building. Air was pulled through a 0.8 micron filter to 3 culture tubes containing equal parts of 0.025 N K2Cr2oO7 and concentrated H2SO4. The volume of air was measured with a wet-test meter. It was concluded that (1) the COD technique can be used as a quantitative measure of the organic gases present, (2) the air COD values can be correlated with noticeable differences in odor level as detected by the human nose, (3) the air COD technique detected different gases when the pH of the manure was above 7.0 than when it was below 7.0, (4) the air COD value rises sharply when the ventilation is turned off and drops sharply when it is turned on again, (5) the air COD values are lowest when the pH of the manure in the pits is in the 6.8 to 7.2 range. The effect of absorbent temperature on the air COD values and the sensitivity of the COD technique to individual organic gases need further exploration. (Schmitt-Iowa State)

0577 - D2

BLOCK DRYING OF CHICKEN MANURE,
Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
A. T. Sobel.
Compost Science, Vol 11, No 3, 1 tab, 1970. p 28-29, 3 fig, 3 ref.

Descriptors: *Farm wastes, *Drying, *Poultry, Moisture content, Odor, Nitrogen, *Waste treatment.
Identifiers: Block drying.

Blocks of chicken manure were air dried to form a storable product with minimum odor. Reductions in weight, volume, nitrogen, and viable organisms were obtained during the drying period and following storage period. Due to moisture loss during drying, the blocks experience a weight reduction to 29 percent of the initial weight. Shrinkage can result in a volume reduction of approximately 50 percent. The reduction in viable organisms over a 3-3/4 period is substantial but a large number of organisms still exist. Nitrogen is lost during the drying and storage period. (Bundy-Iowa State)

0578 - B1, E1, D1, F4

COLLECTION AND DISPOSAL OF FARM WASTES,
Ministry of Agriculture (Northern Ireland).
J. S. V. McAllister.
Water Pollution Control, Vol 69, No 4, p 425-429, 1970. 6 tab, 5 ref.

Descriptors: *Farm wastes, *Slurries, Sewage, Aeration, Incineration, Biochemical oxygen demand, Farm lagoons, Water pollution, Nitrogen, Ammonia, Methane, Hydrogen sulphide, Phosphorous, Waste water disposal, Waste water treatment.

Identifiers: *Pig slurries, *Poultry droppings, *Cattle excreta, Silage.

Improved farming techniques, suburban development, and a wider realization of the necessity to control pollution of the atmosphere and water supplies have increased the problem of farm waste collection and disposal. Generally, in Europe farm wastes are collected in the form of a slurry but disposing of this slurry is a problem. The use of this slurry as a manure has certain drawbacks and alternative methods of disposal such as drying, incineration, aeration treatment, or synthesis of feeding stuffs are explored. (Ellis-Texas)

0579 - A5, D4, E1

OXIDATION DITCHES CAN ELIMINATE ODORS, MANURE HANDLING AND POLLUTION,
John Russell.
Farm Journal, Vol 94, No 8, p H-10, H-15, August 1970.

Descriptors: *Farm wastes, *Hogs, *Waste treatment, Activated sludge, Odors, Aeration.
Identifiers: *Oxidation ditch, *Hog confinement, Odor control, Smart Pork Farm, Lawrence (Kans).

The use of oxidation ditches is described in a swine confinement system for 5000 head annually near Lawrence, Kansas. Thousand head finishing buildings have two oxidation ditches each with 4 rotors or wheels in each ditch. Organic matter removal is in excess of 90 percent. Operating costs approximate one dollar per head. Effluent is discharged to holding ponds for evaporation thereby eliminating all manure hauling. (Miner-Iowa State)

0580 - B2

ENGINEERING PRINCIPLES IN HANDLING LIQUID MATERIALS,
Michigan State Univ., East Lansing. Dept. of Agricultural Engineering.
C. M. Hansen.
Agricultural Engineering, Vol 39, p 546-551, Sept 1958. 13 fig, 1 tab, 8 ref.

Descriptors: *Farm wastes, *Fertilizers, *Pumps, Hydraulic equipment, Liquid wastes, Liquids, Pesticides, Spraying, Herbicides, Hogs, Nematocides, Measurement, Centrifugal pump, Farm equipment, Cattle.
Identifiers: *Dairy cattle, Anhydrous ammonia, Rotameter, Aqua ammonia, Liquid feeds, Helical rotor pump.

Various methods of handling liquid fertilizer, liquid feeds, pesticides, nematocides, and liquid manure are discussed with special emphasis given to the type of pumps recommended for each. Anhydrous ammonia is usually transferred by a bleeding system or a vapor-return system. It is commonly applied to the soil by employment of the pressure differential system. Aqua ammonia is transferred by centrifugal pumps as are many herbicides. Pesticides are recently being applied with air-blast pumps which use both air and water as a carrier of the pesticide. A most successful hydraulic pump for handling soil fumigants has the nylon roller impeller. This pump needs to be flushed with Kerosene or Stoddard solvent. The helical rotor pump with a rubber or synthetic rubber stator is a new pump for handling liquid manure in the semisolid form. By pumping semisolids, a Missouri farmer is able to weekly flush the wastes from a 350-hog installation with only 2,500 gallons of water. Dairy cow wastes are also a semisolid, as 56% of the 12-15 gallons per day water consumption is excreted in the feces while only 13% is excreted in the urine. (Schmitt-Iowa State)

0581 - E2

BROILER LITTER ON WELSH COAL TIPS,
Colin White.
Agriculture. Vol 77, No 2, February 1970, p 49-51.

Descriptors: *Poultry, Farm wastes, *Coal mine wastes, *Land reclamation, Perennial ryegrass, Vegetation establishment, Germination.
Identifiers: *Broiler litter, Field trials, South Wales.

In South Wales large areas of land occur as gigantic coal spoil tips. Interested local authorities are increasingly concerned that disused tips should be landscaped. Presently, however, up to five years may elapse before this land is considered suitable for return to agricultural use. The National poultry laying flock produces 2,000,000 tons of fresh manure per annum. This poultry manure has values that may fit it well for use on derelick land. Tests and trials were arranged to see if poultry manure could ameliorate the harsh conditions presented in trying to establish grass on coal tips. Hen battery slurry was first considered and used in the first germination test. Italian ryegrass seed was mixed with the slurry and applied to tip material. Germination was only about 50%. Next the grass seed was placed on the tip material and then covered by broiler litter. No loss in germination was found with this second method. Field tests were then made using this technique. The results were satisfactory. Further trials and observations are being conducted on tips and restored opencast sites. (Parker-Iowa State)

0582 - A6, B1, F1

CRITERIA NEEDED TO DESIGN ANIMAL QUARTERS FOR COMFORT AND PRODUCTIVITY,
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
T. E. Hazen.
Journal of Animal Science, Vol 32, No 3, p 584-589, 1971. 20 ref.

Descriptors: *Design criteria, Farm wastes, Research needs, Air pollution effects, Farm management, Confinement pens, Investment economics, Temperature control.
Identifiers: Animal quarters, Air purity.

Several reasons account for the shortages in livestock housing design. The most frequent reason is either the added construction or operating cost necessary to obtain something better. Very little is known about the chemical and biological environment systems and the quantitative effects they may have on animal comfort and productivity. In this respect, manure management is now under intensive study because fecal and urinary wastes appear to contribute most to the formation of undesirable conditions. Reasonably adequate data are now available on the treatment and disposal of wastes, but acceptable systems are lacking for separating the manure safely and efficiently from the animal and surroundings. (Bundy-Iowa State)

0583 - A5, A6, C3, D3

AIR POLLUTION FROM AGRICULTURE,
Nebraska Univ., Lincoln. Coll. of Agriculture.
L. F. Elliot, and T. M. McCalla.
Proceedings, Exploring Nebraska's Pollution Problems, symposium article No 31275; Journal Series, Nebraska Agricultural Experiment Station, April 22, 1971. p 1-6, 29 ref.

Descriptors: *Farm wastes, *Air pollution, *Dusts, *Odor, Aesthetics, Erosion control, Land management, Weed control, Pesticide drift, Dust storms, Wind erosion, Pollen, Smoke.
Identifiers: *Allergens, *Fatty-acids, Aerosol drift, Ragweed pollen, Stubble mulching.

The major atmospheric pollutants from agriculture are dust, allergens, odors, pesticides, and smoke. The reduction of these pollutants through improved management practices can be demonstrated. Dust can be controlled by proper cropping systems and management. Allergens can be decreased by weed control. If the surface of animal wastes is maintained aerobically, little or no odor will exist. Problems in reducing odor production in animal confinement units are discussed along with known odor causing chemicals present in these units. However, the control of odors by chemicals are usually of short duration and the chemicals are prohibitively expensive. (Dorland-Iowa State)

0584 - F2

STATE REGULATIONS PERTAINING TO LIVESTOCK FEEDLOT DESIGN AND MANAGEMENT,
Agricultural Research Service, Beltsville, Md. Agricultural Engineering Research Div.
W. F. Schwiesow.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management September 28-30, 1971, The Airlie House, Warrenton, Virginia, p. 19-25, 1 tab.

Descriptors: *Farm wastes, Runoff, Water Quality Act, Regulation, Odor, Permits, Water pollution, *Feedlots.

Uniformity of livestock feedlot design and management regulations is desirable so feedlot operators in one state do not have an advantage over operations in another state. Information is being made available to governmental authorities and other interested people in an endeavor to assist in obtaining a degree of uniformity. Interest in the quality of environment has led to many requests for information on state regulations pertaining to livestock feedlots. A summary of the material received may be categorized as follows: (1) regulations concerning feedlot construction, (2) control through other existing regulations, such as water quality standards or public health requirements, (3) no specific regulations that are considered applicable. Definitions for feedlots vary from state to state. Some states define a feedlot as any livestock confinement area where vegetation suitable for livestock consumption does not grow. Other states specify a minimum number confined at any one time. In most states, a penalty is charged for violation of regulations. Penalties range from $10 to as high as $1,000 fine. All 50 states have water quality standards which have been wholly or partly approved by the federal government. Recently passed legislation on air quality standards will cause the development of additional regulation for feedlot construction and management.

0585 - B1, C4

BOD POSES PROBLEMS FOR POULTRY GROWERS AND PROCESSORS,
Griffith (Llewellyn B.), Falls Church, Va.
C. C. Griffith.
Water and Sewage Works, Vol 117, No 1, p IIW/9-IW/14, Jan-Feb 1970. 1 fig, 3 tab.

Descriptors: *Farm waste, Poultry, Biochemical oxidation demand, Organic matter.
Identifiers: *Poultry processing plant, Broilers, Live weight, Blood waste.

The BOD from poultry processing plants and parameters by which it can be estimated with meaningful accuracy are necessary when designing facilities. Graphs plotted from the data consistently produce a curve whose slope is upward as the size of the bird processed is increased. The BOD load cannot be expressed accurately in terms of production units of either head count or gross live-weight unless the average live-weight per bird processed is considered. The available data is not considered to be sufficiently comprehensive to permit precise calculation of BOD loads imposed by the larger birds of today, but it is adequate to raise a warning flag which should alert those involved to the probability that treatment plants designed according to the old criteria may be underdesigned by a factor of two where 4 lb. birds are being, or soon will be, processed. (Bundy-Iowa State)

0586 - A2, B1

CATTLE FEEDLOTS AND ALTERNATIVES FOR WASTE MANAGEMENT,
Environmental Protection Agency, Portland, Oreg. Water Quality Office.
C. E. Veirs.
Oregon State University, Water Resources Research Institute, Seminar, WR 014.71, July 1971, p 65-76. 9 ref.

Descriptors: *Livestock wastes, *Water quality control, *Confinement pens, Manure lagoons, Settling basins, Land management, Fertilizers, Storm run-off, Nitrates, Groundwater, Incineration, Waste water treatment, Coliforms, Cattle, Sheep, Hogs, Design criteria, Pacific Northwest.

Daily waste production of domestic animals is 10 times the waste production of the human population of the U.S. Per capita beef consumption has risen 34% from 1950 to 1960, while meat consumption overall has risen 15%. To meet the demand, the number of beef cattle in the U.S. has gone from 85 million head in 1945 to 108 million head in 1965, a 27% increase. Prior to the advent of large feedlots, wastes were returned to the land to aid in feed production, but many feed lots have concentrated so many animals that there is not enough land nearby upon which to spread the wastes. Waste treatment facilities are now becoming necessary to these operations. The most common are oxidation lagoons and ditches, although incineration and composting are simulating considerable interest. Sight selection guidelines, design criteria, and waste management suggestions are presented. The development of new techniques and the utilization of known conservation practices can and should be combined to achieve water quality control as well as soil and water conservation.
(Lowry-Texas)

0587 - A5, D1

HYDROGEN SULFIDE AND METHYL MERCAPTANS REMOVALS WITH SOIL COLUMNS,
Washington Univ., Seattle. Dept. of Civil Engineering.
D. A. Carlson, and R. C. Gumerman.
Proceedings of the 21st Prudue Industrial Waste Conference, Extension Series 121, 1966. p 172-191, 14 fig, 3 tab, 8 ref.

Descriptors: *Degradation, *Hydrogen sulfide, Soil bacteria, Soil types, Odor, Sulfur bacteria, Pseudomonas, Anaerobic conditions, Loam, Sands, Clays, *Waste treatment.
Identifiers: *Methyl mercaptan, *Soil filters, Elution water, Sulfuric acid.

Recently, the soil siltration principle has been introduced and successfully applied to odors emanating from sewage. On this basis, a soil filtration system was chosen to experimentally remove hydrogen sulfide and methyl mercaptan from air. Soil columns 3-1/2 feet long were used over a period of six to eight weeks. On concentrations of 15 mg/l hydrogen sulfide and 775 mg/l methyl mercaptan, efficiencies approached 100%. Different types of soil were used with artificially enriched fertile loam soil being superior in degradative ability to clay, sand, and sandy loam soils. No optimum soil depth could be established, since bacterial population was still increasing at the end of the test period. It appears that a depth of 3.5 feet is near the maximum necessary. The effect of gas settling of the mercaptan gas upon entering the soil columns was negligible. A back pressure of 1.5 inches of water existed in a moist fertile loam soil at a flow rate of 0.35 cfm. (Dorland-Iowa State)

0588 - D4

EFFECT OF TEMPERATURE ON AEROBIC DECOMPOSITION OF DAIRY CATTLE MANURE,
Purdue Univ., Lafayette, Ind. Dept. of Agricultural Engineering.
J. C. Nye, A. C. Dale, and D. E. Bloodgood.
Transactions of the ASAE, Vol 14, No 3, p 545-48, May-June, 1971. 8 fig, 3 tab, 7 ref.

Descriptors: *Farm wastes, *Aerobic treatment, *Waste disposal, *Livestock wastes, Ruminants, Sewage disposal, Oxidation, Cattle.
Identifiers: Phenyl pyruvic acid.

Temperature has an effect on the aerobic biodegradation of ruminant fecal wastes, which are about 25% lignin and protein, and 25% undigested feed and bacterial cells. A manure mixture of 2 parts feces and 1 part urine was fed into five decomposition chambers at a rate of 90 grams per 6 liters per day. After 28 days, batch feeding replaced daily feeding in the chambers which ranged in temperature from 35 to 75F. On the 74th day the entire contents of the chambers were dried. When semi-continuous feeding was stopped, the solids concentration of the supernatant decreased to a minimum of 4000 mg/l in the warmest chamber. As this minimum was reached the pH dropped from 7.8 to 5.7 in seven days. This may have been caused by the formation of phenyl pyruvic acid as lignin was transformed to humos. In an aerobic system with a detention period of 74 days at temperatures above 65F, a reduction in volatile solids of 70 percent can be attained. In the same type of system at 48F, only 45% reduction of volatile solids is attainable. A definite change in the rate of decomposition of volatile solids and COD seems to occur between 48F and 56F. (Schmitt-Iowa State)

0589 - A6, C3

VOLATILIZATION OF NITROGEN-CONTAINING COMPOUNDS FROM BEEF CATTLE AREAS,
Nebraska Univ., Lincoln. Agricultural Experiment Station.
L. F. Elliott, G. E. Schuman, and F. G. Viets.
Soil Science Society American Proceedings, Vol 35, p 752-755, 1971. 4 fig, 10 ref.

Descriptors: *Farm waste, *Ammonia, Fertilizer, Pasture, Crop response, Land use, Dust, Cattle.
Identifiers: *Acid trap, *Cattle feedlot, Distillable-nitrogen, Temperature-dependent, Aliphatic amines, Corn stubble.

The release of NH3 plus steam-distillable organic N compounds to the atmosphere from a small beef feedlot and a pasture was measured. Acid traps placed next to the feedlot and 0.8 km from the feedlot averaged 148 and 16 kg/ha per yr NH3 plus steam-distillable organic N compounds, respectively. The same traps averaged 21 and 3.3 kg/ha per yr, respectively, or organic N compounds that were not recovered by the 3 min steam distillation procedure. Feedlot disturbances, such as manure mounding, increased volatilization of N compounds. Ammonia plus steam-distillable organic N compounds trapped near a cattle pasture and cropland averaged 15 and 11 kg/ha per yr, respectively. Organic N compounds not recoverable by the 3-min steam distillation were very low in the areas. Normally, steam distillation values represent only NH3; however, in this case, other N-containing compounds were distilled over and titrated as NH3. (Bundy-Iowa State)

0590 - B1, D1, E1

THE MISSOURI APPROACH TO ANIMAL WASTE MANAGEMENT,
Missouri Univ., Columbia. Dept. of Agricultural Engineering.
R. M. George, M. R. Peterson, C. G. McNabb, J. W. Robbins, and G. B. Garner.
Missouri Water Pollution Board and Extension Division, University of Missouri - Columbia, MP232/71/1M, p1-65. 21 tab.

Descriptors: *Farm waste, *Lagoon, *Design standards, Aeration, Filtration, Oxidation, Waste disposal, Irrigation, Design, Sprinkler irrigation, Farm management, Swine, Cattle, Anaerobic bacteria, Soil disposal fields.
Identifiers: *Soil-plant filter, System management, Solid manure.

Livestock producers have asked for guidelines on animal waste management that will be feasible and enduring. With these facts in mind, staff engineers of the Water Pollution Board held a series of meetings with staff members of the Extension Division and Department of Agricultural Engineering of the University of Missouri-Columbia, to develop guidelines for disposal of waste from confinement feeding operations. The information and design guidelines are intended primarily for the use of personnel in agencies concerned with animal waste management systems, including detailed information on the components; that is, settling basin and a detention basin. Lagoon systems were outlined giving component parts and sizing with some cost estimates. Guidelines were also given for final waste disposal, including tankwagons and irrigation from pits and lagoons. The effects of these systems on the surroundings were also discussed. (Bundy-Iowa State)

0591 — A2, A3, F4

AGRICULTURAL POLLUTION OF THE GREAT LAKES BASIN,
Deputy Minister, Ontario, Department of Agriculture and Food.
Allen Cywin, David Ward.
Agriculutral Pollution of the Great Lakes Basin. Environmental Protection Agency Water Quality Office, combined Report by Canada and the United States 13020, July, 1971. p. 1178, 4 fig. 50 tab, 22 ref.

Descriptors: *Farm Waste, runoff, nutrients, pesticides, herbicides, chemicals, Fertilizers, eutrophication, Waste disposal, chloride, nitrogen, phosphorus.
Identifiers: *Great Lake Basin, Canada, United States.

This report is intended to be a State-of-the-Art document concerning abatement of pollution of the Great Lakes Basin, as specifically influenced by agricultural and related sources. It was compiled by technical personnel, from appropriate fields in universities and governmental departments in Canada and the United States. Primarily it relates to the identification of the impact of agricultural and related activities on the pollution of the Great Lakes Basin. The major constituents of these non-point sources of pollution which were studied included: 1) runoff and release of nutrients, pesticides, and herbicides and degradation by-products as a consequence of the application of agricultural chemicals; 2) runoff of pollutants from animal and poultry production operations and from associated animal waste management structures and lands used for ultimate disposal; 3) sedimentation resulting from current land use practices, including land influenced by agricultural activities and by local, state and federal activities on public lands, highways and parks. Also under study was the scope of current planning, advisory and regulatory functions of the United States and Canadian Governments. The findings of some of the basic research conducted to date by both Nations, and the substance of the programs is one of motivating development of more comprehensively effective and universally applicable methodology for the management of wastes from agricultural and related activities, and the amelioration of the invaluable water resources throughout the Great Lakes Basin. (Bundy - ISU).

0592 - A3, A9, C3, F3

PLANT NUTRIENTS AND ANIMAL WASTE DISPOSAL,
Connecticut Agricultural Experiment Station, New Haven.
Charles R. Frink.
Connecticut Agricultural Experiment Station Circular 237, May 1970. 10 p, 1 tab, 1 fig, 13 ref.

Descriptors: *Farm wastes, *Waste disposal, *Environmental effects, *Public health, *Nutrients, *Connecticut, Sewage treatment, Fertilizers, Nitrogen, Dairy industry, Phosphorus.
Identifiers: *Plant nutrients.

Plant nutrients released to the aquatic environment permit the growth of abundant weeds and algae and complicate present efforts to provide clean water for Connecticut citizens. These nutrient sources include domestic sewage, animal wastes, fertilizers used on both farm and lawns, and nitrogen oxides from high temperature combustion. Although the economic return from the plant nutrients in farm manure is marginal at best, we can no longer afford the consequences of regarding manure simply as waste to be disposed. Continuing efforts should be made to keep adequate land area in crops. Methods of assessing the human health hazard from the disposal of farm wastes should be examined. Research on methods for storage and handling farm manure should be continued, with the ultimate aim at storage and distribution system so that manure is applied to growing crops and not to bare or frozen soil. Research should be continued on new agronomic practices to improve the uptake by the crop of the nutients in the applied manure. (Parker-Iowa State)

0593 - F1, F4

ANIMAL WASTE MANAGEMENT.
Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971. The Airlie House, Warrenton, Virginia, 205 p.

Descriptors: *Farm wastes, Legislation, Cattle, Lagoons, Oxidation lagoons, Waste disposal, *Water pollution sources.
Identifiers: *State legislation, Animal waste management.

This proceeding represents a record of the first meeting that was ever co-sponsored by the U.S. Department of Agriculture, Environmental Protection Agency, Council of State Governments, National Association of State Universities and Land Grant Colleges, and National Association of State Departments of Agriculture. The purpose: to focus on a problem with which they all have an interest and responsibility. There is no doubt of the public concern in a cleaner environment, including clean streams and waterways. At the same time, food requirements increase with the growing population and this has resulted in heavier concentration of livestock and poultry production which are contributing to the pollution of our streams. Thus it is the animal waste management becomes a matter of public concern. Under such circumstances the farmer and rancher who raise livestock and poultry are subjected to both Federal and State laws and regulations. This symposium provided an opportunity for these different interest groups to meet together and share experiences, knowledge, and concerns and hopefully to come up with recommendations that will help assure attainment of our environmental objectives.
(Bundy-Iowa State)

0594 - F3

IMPROVED CONTROL OF ANIMAL WASTES,
Department of Agriculture, Washington, D.C.
J. P. Campbell.
In: Animal Waste Management Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971, The Airlie House, Warrenton, Virginia, p. 7-9.

Descriptors: *Farm wastes, Permits, Local governments, Regulation, Odor, Water pollution, Fertilizers.
Identifiers: *State laws.

The management of animal waste requires immediate attention. Animal wastes in this country are one of the significant sources of waste in our agricultural industrial-commercial-domestic complex. Fortunately, most of the waste is disposed on the land and does not constitute an environmental pollution threat. The problem stems from increased demand for meat and the modern farming techniques. Eighty to 90 percent of swine, poultry, and broilers are raised in concentrated areas. Where this production is in close proximity to urban, recreational, and other areas heavily used by

people, problems of odors, insects, rodents, and dust can arise. Stream pollution can be a problem even in more remote areas. A successful attack on the problem of animal wastes requires cooperation among USDA, the Environmental Protection Agency, State and local agencies, and private enterprises. The prevention of agricultural pollution must be based on atechnology that has been thoroughly tested and proved as (1) economically feasible for producers, (2) safe with reference to the quality of products, and (3) protective of the public's rights to a clean environment.
(Bundy-Iowa State)

0595 - A1, F3

ANIMAL WASTE MANAGEMENT AND THE ENVIRONMENT,
Environmental Protection Agency, Washington, D.C. Office of Categorical Programs.
D. D. Dominick.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971, The Airlie House, Warrenton, Virginia, p. 11-14.

Descriptors: *Farms wastes, Odor, Local governments, Regulation, Water pollution, Feed lots, Legislation, Water Quality Act.

In a report to the President in 1969, entitled 'Control of Agriculture - Related Pollution,' prepared by the Department of Agriculture and the Office of Science and Technology, it was indicated that animal wastes resulting from confined livestock feeding operations created one of the country's three main agricultural pollution problems. The other two pollution problems related to agriculture are caused by irrigation return flows and sediment-laden runoff. These feedlot pollution problems could have been minimized if care had been taken in locating the feedlot. Most states have long-standing public health and nuisance laws that, theoretically, govern livestock and poultry operations with regard to flies and other disease vectors, odors, and dust. However, these statutes do not address the whole spectrum of air, water, and land pollution caused by feedlots. The Environmental Protection Agency has recently set up a Rural Wastes Section in the Office of Water Programs. This section is devoted to agricultural pollution problems, and will be addressing the overall problems of animal wastes. It will be developing guidelines for control, such as determining how much treatment is necessary, and will be providing direction in training and research.
(Bundy-Iowa State)

0596 - F2

SUMMARY OF EXISTING STATE LAWS,
National Association of State Departments of Agriculture, Washington, D.C.
W. S. Cath.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971, The Airlie House, Warrenton, Virginia, p. 17-18.

Descriptors: *Farm wastes, Runoff, Regulation, Pollution, State governments, *Feedlots.

Registration of new feedlots is a part of published regulations. In some states existing feedlots are required to register within a specified time. In other states, existing feedlots are not notified of pollution potential and someone calls this to the attention of the pollution control authority. When this occurs, the control authority requires the operator to register the feedlot and to provide the necessary information. In some states feedlots would not have to register because of the size limitation but can registerif they prefer to do so. A state has responded to the animal waste runoff problem in one of the three following manners: either, developed regulations concerning feedlots construction, have control through other existing regulations such as water quality standards or public health requirements, or no specific regulations are considered applicable at this time.
(Bundy-Iowa State)

0597 - B1, F2

STATE REGULATIONS PERTAINING TO LIVESTOCK FEEDLOT DESIGN AND MANAGEMENT,
Agricultural Research Service, Beltsville, Md. Agricultural Engineering Research Div.
W. F. Schwiesow.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management September 28-30, 1971, The Airlie House, Warrenton, Virginia, p. 19-25, 1 tab.

Descriptors: *Farm wastes, Runoff, Water Quality Act, Regulation, Odor, Permits, Water pollution, *Feedlots.

Uniformity of livestock feedlot design and management regulations is desirable so feedlot operators in one state do not have an advantage over operations in another state. Information is being made available to governmental authorities and other interested people in an endeavor to assist in obtaining a degree of uniformity. Interest in the quality of environment has led to many requests for information on state regulations pertaining to livestock feedlots. A summary of the material received may be categorized as follows: (1) regulations concerning feedlot construction, (2) control through other existing regulations, such as water quality standards or public health requirements, (3) no specific regulations that are considered applicable. Definitions for feedlots vary from state to state. Some states define a feedlot as any livestock confinement area where vegetation suitable for livestock consumption does not grow. Other states specify a minimum number confined at any one time. In most states, a penalty is charged for violation of regulations. Penalties range from $10 to as high as $1,000 fine. All 50 states have water quality standards which have been wholly or partly approved by the federal government. Recently passed legislation on air quality standards will cause the development of additional regulation for feedlot construction and management.

0598 - F2, F3

MODEL STATE STATUTE FOR ANIMAL WASTE CONTROL,
Council of State Governments, Washington, D.C.
R. D. Conrad.
Council of State Governments, Washington, D.C.

Descriptors: *Regulation, *Legal aspects, *Farm wastes, *Standards, Confinement pens, Permits, State governments, Civil law, Effluents, Water quality control, Inspection, *Feedlots.
Identifiers: Effluent standards.

A model state statute for animal waste control is presented in an attempt to develop an effective legislative control. Operations which are in compliance with the statute are presumed not to constitute a nuisance. The statute establishes minimum animal numbers in confinement for an operation to be subject to the permit programs. It also establishes that permits shall be needed for the operation and construction of a livestock operation with more than the minimum animal numbers. The statute designates how a permit may be revoked, allowing the operator an opportunity for a hearing. The state legislation should provide protection to those in compliance from harassing legal action and provide stability in administration.
(Dorland-Iowa State)

0599 - F2

THE MINNESOTA SCENE LIVESTOCK FEEDLOT, WASTE CONTROL, PROGRESS – PROBLEMS,
Minnesota Dept. of Agriculture, St. Paul.
R. M. Dennistoun.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971, The Airlie House, Warrenton, Virginia. p. 33-35.

Descriptors: *Farm wastes, Regulation, Permits, Livestock, *Minnesota, Feed lots.
Identifiers: Minnesota Pollution Control Agency, Permit applications.

Regulations for the control of waste from livestock feedlots, poultry lots, and other animal lots were developed and officially adopted in April, 1971 by the Minnesota Pollution Control Agency. These regulations were developed to comply with the specific policy and purpose of the State of Minnesota in regard to solid waste control as set forth be Minnesota Statutes. The Agency has prepared 'Permit Application' forms which are to be completed by each operator who plans to 'CONSTRUCT' AND/OR 'OPERATE' A LIVESTOCK FEEDLOT, POULTRY LOT OR OTHER ANIMAL LOT. The application includes those existing feedlots that are 'noncomforming' lots, which means that they do not meet the standards or criteria of some solid waste regulations.
(Bundy-Iowa State)

0600 - F2

STATE OF OKLAHOMA ACTIVITIES IN ANIMAL WASTE MANAGEMENT,
Oklahoma Board of Agriculture, Oklahoma City.
B. R. Gowdy.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971, The Airlie House, Warrenton, Virginia, p. 37-39.

Descriptors: *Farms wastes, Waste disposal, Regulation, Permits, Feedlots, Livestock, *Oklahoma, *Water pollution control.
Identifiers: *Feed Yard Act, Oklahoma, Board of Agriculture.

The Oklahoma Legislature, in 1969, recognized the potential problem of animal waste disposal and enacted a 'Feed Yards Act,' with administrative responsibility in the State Board of Agriculture. A 'feed yard' was defined as an area where more than 250 head of livestock were being fed for slaughter and in which there was no growing vegetation intended for livestock feed. The law requires the feed yard operator to (1) provide adequate control of pests, (2) provide reasonable methods for the disposal of animal excrement, (3) provide adequate drainage from the feed yard premise of surface waters falling upon the area occupied by the feed yard so as not to pollute any stream, lake, river or creek, (4) provide adequate veterinarian services to detect, control, and prevent the spread of livestock diseases, (5) have available for use at all necessary times, mechanical means of scraping, cleaning, and grading feeding yard prmises, (6) provide weather-resistant aprons adjacent to all permanently affixed feed bunks, water tanks and feeding devices, and (7) conduct feed yard operations in conformity with established practices of the industry as approved by regulations adopted by the Board.
(Bundy-Iowa State)

0601 - F3

PROPOSED ANIMAL WASTE POLLUTION CONTROL LEGISLATION IN NORTH CAROLINA,
North Carolina Univ., Chapel Hill. Inst. of Government.
M. S. Heath, Jr.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Manage-

ment, September 28-30, 1971, The Airlie House, Warrenton, Virginia, p 41-43.

Descriptors: *Farm wastes, Regulation, Permits, Waste disposal, Feed lots.
Identifiers: Proposals.

North Carolina is considering legislation on the subject of animal waste control and management. During the recently concluded 1971 legislative session, a bill proposing a survey and planning process leading to administrative controls was considered but not approved. North Carolina, within the past year, has developed three separate proposals involving legislation on animal waste management and control. The first proposal, a draft bill cast in the familiar form contemplating regulation through permits for all animal or poultry producing units, never was formally introduced for legislative consideration. The second proposal, retaining the general rule-making power of the original draft but substituting a survey and planning phase for permit requirements, was introduced very late in the 1971 legislative session and died in committee. The third proposal, contemplating a study of animal waste management and control by the legislature's interim study commission, was adopted. (Bundy-Iowa State)

0602 - F2

STATE OF VIRGINIA ACTIVITIES IN ANIMAL WASTE MANAGEMENT,
Virginia State Water Control Board, Richmond.
L. G. Lawson.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971, The Airlie House, Warrenton, Virginia, p 45-47.

Descriptors: *Farm wastes, Runoff, Waste disposal, Livestock, Feed lots, Legislation, *Virginia.
Identifiers: Point source discharge.

The Virginia State Water Control Law, first enacted in 1946, was amended by the 1968 and 1970 general assemblies to broaden and strengthen the authority of the Water Control Board. The Board's powers to regulate municipal and industrial waste discharge are well defined and the law specifically spells out procedures for certification of such discharge. The Virginia pollution control law can be summarized as follows: (1) The present state water control law applies primarily to point source discharge. (2) Standards have been approved pertaining to non-discharging lagoons, and the procedures for issuing these types of certificates are well-defined. (3) The present state law does not adequately apply to diffuse sources of pollution. (4) Legal procedures involving animal waste have proved workable in the past. (5) There has been excellent cooperation from the other agencies in the state that are involved with animal waste. (Bundy-Iowa State)

0603 - B1, F4

EFFLUENT DISCHARGE GUIDELINES AND ANIMAL WASTE MANAGEMENT TECHNOLOGY,
Environmental Protection Agency, Washington, D.C. Office of Research and Monitoring.
H. Bernard, J. Denit, and D. Anderson.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971. The Airlie House, Warrenton, Virginia, p 69-83, 7 fig, 7 tab, 10 ref.

Descriptors: *Farm wastes, *Pollution abatement, *Treatment, Confinement pens, Aeration, Aerobic treatment, Biological treatment, Digestion tanks, Disposal, Farm lagoons, Organic loading, Soil disposal fields, Runoff, Feed lots, Oxidation lagoons.
Identifiers: *Zero discharge, Bio-filter.

We have arrived at the 'age of the feedlot.' More animals are housed, more feed consumed, and more meat produced in any given restricted locale than ever before. In addition to the consumable products, feedlots now produce upwards of 1.5 billion tons of raw manure annually. Environmental impact notwithstanding, under these situations the physical problem of merely keeping the pens, barns, or houses even reasonably clean can be overwhelming. The Environmental Protection Agency research effort is being directed at developing and demonstrating an array of waste management procedures which effectively 'close the loop' against waste discharges. Essentially the effort is to provide farmers with the ability to apply the concept of 'Zero-Discharge' of waste flows. Several possible solutions are presented, a 'spray-runoff' concept, an oxidation ditch, and the 'barriered landscape water renovation system.'

0604 - B1, F4

STATUS OF DAIRY CATTLE WASTE TREATMENT AND MANAGEMENT RESEARCH,
Purdue Univ., Lafayette, Ind. Dept. of Agricultural Engineering.
A. C. Dale.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971, The Airlie House, Warrenton, Virginia. p 85-95, 6 tab, 3 fig.

Descriptors: *Farm wastes, *Dairy industry, *Runoff, Environmental sanitation, Liquid wastes, Fertilization, Odors.
Identifiers: *Field spreading.

Dairy-cow herds are proportionately small, averaging about 30 to 40 cows per farm. Although the trend in size is upward, the rate of increase is quite low, and it appears an average herd size of 70 to 80 cows may be reached about 1990. Dairyman have generally done a good job of returning their wastes to the soil. Sanitarians and other health officers that visit grade A dairys have probably had some influence. Liquid handling is now being readily accepted and adapted to the dairy operation, but handling the manure as a semi-solid is still the preferred way. Typically farm acreages are more than 1/2 acre per dairy cow, thus sufficient land is available for adsorption and utilization of the wastes produced without polluting the soil, water or air. Runoff from outside feeding floors appears to be the most difficult problem confronting dairymen. Lagoons are the most satisfactory method of intercepting such runoff, but the excess supernatant must be irrigated onto land and not permitted to overflow into water resources. Aeration can be used to control odors emanating from lagoons. (Schmitt-Iowa State)

0605 - A3, A4, F3

CATTLE FEEDLOT POLLUTION,
F. G. Viets.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971, The Airlie House, Warrenton, Virginia, p 97-105, 2 tab, 13 ref.

Descriptors: *Farm wastes, *Confinement pens, *Runoff, Groundwater, Fertility, Soil properties.
Identifiers: *Land spreading, Zoning.

Per capita beef consumption in the United States has increased 3.5% per year for the last 20 years. This coupled with the apparent profitability of large integrated feeding and slaughtering operations indicate that feedlots will grow larger and not smaller. We have never experienced such a concentration of wastes on so small an area as some of our high density feedlots. Because stream and lake pollution from runoff is now prohibited, engineers are challenged to design facilities that minimize runoff or dispose of it economically and, hopefully, beneficially. The solution to the problem is to return the solid waste to the land in sufficient amounts for near maximum production of crops without waste of the animal feces resource. Underground water pollution appears to be a mostly local phenomenon. Widespread contamination of aquifers does not appear probable. Most of the unsolved problems lie in the air pollution area. The significance of increased levels of ammonia in the air to surrounding crops and lakes needs further study. Only about one tenth of the land needed to produce foodstuffs for cattle is needed for productive waste disposal. Zoning appears to be one of the best solutions to the feedlot problem. Such zoning should include provision for adequate land for manure and runoff disposal.
(Schmitt-Iowa State)

0606 - A1, F4

POULTRY WASTE MANAGEMENT,
Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
R. C. Loehr.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971. The Airlie House, Warrenton, Virginia. p 107-110.

Descriptors: *Farm wastes, *Poultry, *Waste storage, Eutrophication, Drying, Odors.
Identifiers: *Field spreading.

In most areas of the United States, if an egg producer does not have anywhere from 15 to 30 thousand birds under his control, he is not a major egg producer. The major egg producers usually have production complexes around three hundred thousand birds. In the general commercial house of today, the wastes are defecated through the cages to pits below the cages. Anaerobic conditions occur in the pits and when the wastes are spread, odors are released. All alternatives in storing wastes include either aeration or drying combined with land disposal. It is extremely unlikely that the quality of aeration systems can be made such that the resultant effluent can go directly into any body of water. The place to put agricultural wastes is back on the land. The problem of nutrient control is another factor which requires concern when investigating alternative approaches for agricultural waste management. In the case of nitrogen removal, ammonia released to the atmosphere is not the best approach because of the environmental problem that can result when it comes down. This demonstrates the need to determine overall rather than piecemeal solutions.
(Schmitt-Iowa State)

0607 - A1, F4

SWINE WASTE MANAGEMENT,
Illinois Univ., Urbana. Dept. of Agricultural Engineering.
A. J. Muehling.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971. The Airlie House, Warrenton, Virginia. p 111-119, 7 fig, 2 tab, 9 ref.

Descriptors: *Farm wastes, *Waste disposal, Farm lagoons, Waste storage, *Runoff, Irrigation practices, Confinement pens.
Identifiers: *Field spreading, Pasture and recycling.

In the 10 Corn Belt states where over 80% of the hogs were sold in 1964, the number of farms selling hogs declined 27% from 1959 to 1964, but the number of hogs sold increased 6%. The adoption of slatted floors has done much to influence the trend toward confinement by reducing or almost eliminating handcleaning and making it possible to pump and handle the wastes with mechanical equipment. The confinement operator has all the wastes confined, so he only needs to adapt a suitable method of disposal to avoid pollution. Due to high nutrient strength as well as high BOD concentration, it appears swine wastes must be returned to the soil. Due to dispersion, hogs on pasture have a low water pollution potential unless they have access to a stream. Swine production systems using solid floors and bedding has high pollution potential if part of the floor is uncovered. The major problems with spreading liquid manure from storage pits are the odors immediately after spreading and danger from runoff if spread on rolling land or frozen ground. Lagoons seldom purify liquids so that they may be released into a natural watercourse. Strong odors are associated with anaerobic lagoons. Although oxidation ditches are virtually odorless, the effluent is not purified to pollution control standards. Hydraulic manure removal minimizes odors but some type of recycling system is normally required. Dehydration, incineration, and composting are not feasible at this time. (Schmitt-Iowa State)

0608 - E1

RECYCLING OF ANIMAL WASTES,
Agricultural Research Service, Beltsville, Md. Agricultural Engineering Research Div.
R. G. Yeck, and P. E. Schleusener.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971. The Airlie House, Warrenton, Virginia, p 121-127, 2 fig, 3 tab, 18 ref.

Descriptors: *Farm wastes, *Reuse, Fertilization, Nutrition, Phosphorus, Nitrogen.
Identifiers: *Recycling.

With much concern over upsetting the earth's delicate ecological balance, we seek the ideal of having all earthly activities fit into one mammoth recycling system. The present system of animal production is inefficient as it fails to take advantage of the feed value left in waste and the wastes are considered an environmental contaminant. Land recycling is currently the best available practice and will probably continue as a prime method for recycle for several years. Some recycling processes have feed as their only product, some produce nonfeed by-products such as methane gas, industrial chemicals, or water. The actual feed value of a specific animal waste is dependent on the waste used, the species to which it is fed, and the process used. The total protein output for any process will, of course, be limited by the nitrogen that was initially in the animal waste. Other constituents of value in animal waste include calcium, phosphorus, starch, and structural polysaccharides. Addition of sodium hydroxide or sodium peroxide increases the digestability of wastes significantly. Ensiling mixtures of manure and grasses seems to have much potential as a refeeding process. Lagooning, hydroponics, insect culture, earthworm culture, fish culture, algae production, yeast production, and single cell protein culture are other processes that might prove to be acceptable economical recycling processes. (Schmitt-Iowa State)

0609 - F2, F3

REGULATORY ASPECTS OF RECYCLED LIVESTOCK AND POULTRY WASTES,
Food and Drug Administration, Rockville, Md. Bureau of Veterinary Medicine.
J. C. Taylor.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971, The Airlie House, Warrenton, Virginia. p 129-131. 4 ref.

Descriptors: *Farm wastes, *Reuse, *Regulation, Legal aspects, Inter-agency cooperation.
Identifiers: *Refeeding, Poultry litter.

The current Food, Drug, and Cosmetic Act of 1938 prohibits interstate commerce in adulterated or misbranded foods and drugs. On September 2, 1967 the Food and Drug Administration published Section 359, which is a formal statement of policy under subchapter A, Title 21 of the Code of Federal Regulation. This section states that the FDA has not sanctioned and does not sanction the use of poultry litter as a feedstuff for animals although it has been recoded to Subpart B of Part 135, Section 135.104. This policy statement is considered to be a general statement applying to all waste products proposed as a component of the diet of animals. The reasons given are that wastes may be expected to contain drugs and antibiotics or their metabolites and that disease organisms may be transmitted through the wastes. The Bureau of Veterinary Medicine has received authorization to contact representatives of the Environmental Protection Agency, the U.S. Dept. of Agriculture, the National Institutes of Health, and the Association of American Feed Control officials in an attempt to better coordinate the efforts of agencies concerned with recycling wastes. The three basic catagories of information desired on waste products submitted to the FDA for review are (1) establishing nutritive value, (2) determining safety to animals and (3) determining food from these animals is safe for man.
(Schmitt-Iowa State)

0610 - A2, A3, A4, F1

WATER POLLUTION AND THE FARMER,
Congress, Washington, D.C.; and House, Washington, D.C.
F. Schwengel.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971, The Airlie House, Warrenton, Virginia, p 133-135.

Descriptors: *Farm wastes, *Runoff, *Government finance, Costs, Waste disposal, Pesticides.
Identifiers: Financial return.

The definition of pollution might be 'An unfavorable alteration of our surroundings manifested by a degradation of the physical, chemical, and biological characteristics of the associated land, water and air.' Agriculture is concerned with at least four major sources of water pollution: sediment, animal wastes, nutrient runoff from fertilizer use, and pollution from pesticides. There are at least two primary reasons that farm and non-farm industries have neglected certain aspects of waste disposal. First, control measures demand an added investment without a commensurate financial return, and second, changing production practices have made it more difficult to dispose of wastes. Despite the magnitude of agricultural pollution, funding by Congress continues at a modestly inadequate rate. Only a little more than $100 million a year will be spent on watershed development projects during the next few years, whereas a funding rate of $500 million annually is needed to accomplish the objectives of minimizing agricultural run-off, silting, and other sources of pollution. If we do not address ourselves to the agricultural pollution problem, we will not achieve our objectives. (Schmitt-Iowa State)

0611 - A1, B1, F4

U.S.D.A. TECHNICAL AND FINANCIAL ASSISTANCE PROGRAMS,
Department of Agricultural, Washington, D.C. Science and Education.
T. C. Byerly.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971, The Airlie House, Warrenton, Virginia, p 139-141.

Descriptors: *Farm wastes, *Administrative agencies, *Government supports, Water resources development.
Identifiers: *Agricultural Research Service, Cooperative State Research Service, Economic ResearchService, Soil Conservation Service.

Three research agencies of the Department of Agriculture provide technical and financial assistance. These include the Agricultural Research Service, the Cooperative State Research Service, and the Economic Research Service. The Soil and Water Conservation Research Division of the Agricultural Research Service is responsible for such things as air pollution and water pollution by feedlots. The engineering group of this division is constantly seeking new structures that can contain, divert, or reduce pollution. The animal husbandry group looks into the possibility of recycling waste as feed. The Cooperative State Research Service administers about a million dollars worth of funds annually throughout the states on pollution control research. The containment, diversion, reduction, and utilitization of waste are areas of concern. The Economic Research Service is responsible for evaluation of alternate methods of waste management and the evaluation of the economics of scale, organization of feedlot enterprises, and the efficiency of feedlot production. Agencies that provide the bulk of technical assistance as well as some financial assistance include the Soil Conservation Service, the Farmers Home Administration, the Farmer's Cooperative Service, the Agricultural Research Service, and the Extension Service. The Soil Conservation Service has information available for all problems in the area of structure design. The Extension Service is a very good information delivery system as it is present in every county. (Schmitt-Iowa State)

0612 - A1, B1, F1

PROVIDING TECHNICAL AND FINANCIAL ASSISTANCE TO FARMERS FOR ANIMAL WASTE DISPOSAL SYSTEMS,
Farm Credit Administration, Washington, D.C.
G. L. Swackhamer.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971, The Airlie House, Warrenton, Virginia, p 143-145.

Descriptors: *Farm wastes, *Credit, *Loans, Financing, Economic feasibility, Pollution abatement.
Identifiers: *Farm Credit System, Federal Land Bank, Production Credit Association, Banks for Cooperatives.

The Cooperative Farm Credit System is a privately owned and managed system of credit services to farmers, ranchers, and their cooperatives. It is comprised of Federal Land Banks, Production Credit Associations, and Banks for Cooperatives. The funds used by the System are obtained from the sale of bonds and debentures to private investors through a Fiscal Agency, and is regulated by the Farm Credit Administration, an independent agency. It appears desirable that some guidelines for decisions involving pollution control facilities be established, since the amount of credit required to finance animal waste systems is sizable and varies widely, and frequently, credit-worthy farmers have encountered difficulty in financing waste systems. Farm Credit banks have concluded that cooperatives have more waste management problems than individuals, relocation is often the method of resolving pollution problems, expenditures for waste disposal systems frequently lead to cost overruns, both lenders and borrowers are frequently ignorant of current laws and regulations, no single method of handling animal wastes is best in all cases, and amounts for pollution control are often intertwined with total credit requests and may not receive adequate attention. Reconciliation of social benefit-cost issues with private investment-production decisions is producing new considerations for both lenders and borrowers. (Schmitt-Iowa State)

0613 - A1, B1, F1

TECHNICAL AND FINANCIAL ASSISTANCE

FOR THE CONTROL OF ANIMAL WASTES,
Environmental Protection Agency, Washington, D.C. Office of Water Programs.
K. M. Mackenthun.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971, The Airlie House, Warrenton, Virginia. p 147-149.

Descriptors: *Farm wastes, *Administrative agencies, *Government supports, Water resources development, Federal Water Pollution Control Act.
Identifiers: Solid Wastes Disposal Act.

In confined animal feeding, manure becomes a liability for both the operator and the public, as it is a repository for diseases and pests and it is a catastrophic polluter when it reaches a waterway. Runoff from cattle feedlots can be toxic to aquatic life, remove needed oxygen from the water, and supply food for the development of nuisance biological pests. The Environmental Protection Agency has a number of grants for research and demonstration and technical assistance activities that are applicable to the control of animal feedlot wastes. Grants are authorized under Section 6 (b) of the Federal Water Pollution Control Act with the prime objective to develop by the late 1970's techniques for the complete elimination of point-source wastes, as well as to develop and demonstrate technology for the renovation of wastewaters for reuse. Technical assistance is available in the Office of Water Programs' Division of Technical Support and in comparable support groups within the ten regions of the Environmental Protection Agency. Both the Solid Waste Disposal Act and the Federal Water Pollution Control Act provide grants to assist state, interstate, municipal and inter-municipal agencies and organizations in development of plans and programs for solid waste and water pollution control. Regional EPA Administration should be contacted for Agency assistance. (Schmitt-Iowa State)

0614 - B1, F1

SMALL BUSINESS ADMINISTRATION PROGRAMS TO PROVIDE FINANCIAL AND TECHNICAL ASSISTANCE TO SMALL FIRMS IN SOLVING PROBLEMS RELATIVE TO ANIMAL WASTE DISPOSAL,
Small Business Administration, Washington, D.C. Office of Financial Assistance.
A. E. Armstrong.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971, The Airlie House, Warrenton, Virginia. p 151-152.

Descriptors: *Farm wastes, *Administrative agencies, *Government supports, Water resources development, Pollution abatement.
Identifiers: *Small Business Administration.

It is the policy of the Small Business Administration to make, participate in, or guarantee loans to small firms for any worthy business purpose, which includes waste disposal of any kind. Consideration is given to increasing loan amounts requested to provide for acquisition and installation costs of waste disposal or waste treatment facilities with the same approach being permitted in respect to air and solid waste pollution. It is possible for the SMA to launch new business operations such as those in the processing or recycling waste field, but they are very difficult to handle. If an existing business wishes to purchase or install recycling or reprocessing equipment this would be treated as normal business expansion. Since SBA is a lending agency, it is concerned with credit criteria or requirements. As any other lender, it is interested in the character of its borrowers and in repayment ability, management ability, capitalization, and collateral. For lending purposes a business qualifies as a small business, generally, if it retails less than $1 million annually. The classification of a manufacturing concern is based on the number of employees and can range from less than 250 to less than 1,500 depending upon the industry. SBA is not empowered to make any type loan or guarantee to agricultural enterprises, being limited in its activities to commercial operations. (Schmitt-Iowa State)

0615 - B1, F1

FINANCIAL ASSISTANCE FOR THE CONSTRUCTION AND IMPROVEMENT OF IRRIGATION SYSTEMS,
New Mexico State Government, Santa Fe. Office of State Engineer.
J. C. Yates.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971, The Airlie House, Warrenton, Virginia. p 153-155.

Descriptors: *Farm wastes, *Administrative agencies, *Government supports, Water resources development, Pollution abatement.
Identifiers: *Community ditches, Soil Conservation Service, Agricultural Stabilization and Conservation Service, Four Corners Regional Commission.

Funds for programs relating to water supplies for irrigation, and projects for the construction and improvement of irrigation systems are from a trust fund account established by the Congress of the United States (Act of Congress 30 Stat. 484) in 1898 to the Territory of New Mexico. For that portion of the Southwest that was acquired by the United States from Mexico, the community ditch is an institution peculiar to the native people, and the customs governing community ditches are written into law. Through the cooperation of the Agricultural Stabilization and Conservation Service, the Soil Conservation Service, the Four Corners Regional Commission, and local ditch organizations, nearly all ditches have been improved through concrete ditch lining, plastic and concrete pipelines and appurtenances for the distribution of water, works for flood protection of irrigation structures, construction of diversion dams, ditch headings and sluiceways, and improvement of impoundment dams. In addition to grants and loans to community ditches, the Interstate Stream Commission has loaned to irrigation and conservation districts about $1.8 million for lining ditches, leveling land, and undertaken similar conservation practices. The success of the cooperative irrigation systems improvement program may encourage others to seek acceptable Federal-State-Local programs for animal waste management. (Schmitt-Iowa State)

0616 - A3, B1, F3

THE LAKE MENDOTA WATERSHED PROJECT,
Wisconsin Univ., Madison.
D. G. Last.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971, The Airlie House, Warrenton, Virginia. p 163-167, 1 ref.

Descriptors: *Farm wastes, *Administrative agencies, *Waste storage, Government supports, Pollution abatement.
Identifiers: *Agricultural Stabilization and Conservation Service, Soil Conservation Service, Rural Environmental Assistance Program, Lake Mendota.

In 1966, the Lake Mendota Problems Committee prepared a report entitled, 'Report on the Nutrient Sources of Lake Mendota.' Evidence was presented showing 30% of the phosphorus which entered the lake stemmed from runoff from agricultural land on which manure had been spread. Potential for this type of runoff was particularly high during the winter when snow cover or frost made the soil impermeable. It was decided lake improvement could be accomplished by recommending methods for handling animal wastes that decrease water pollution. Through the cooperation of the Agricultural Stabilization and Conservation Service, the Soil Conservation Service, and the University of Wisconsin Extension office, storage strhetures were built on a cost-sharing basis for those livestock facilities needing them. Despite the voluntary basis for this project, it is felt the Rural Environmental Assistant Program's stated goal: 'To improve the quality of life for all people by preventing or abating environmental pollution; providing the maximum public benefit; and conserving the land and related natural resources,' has been accomplished. (Schmitt-Iowa State)

0617 - A1, B1, F4

THE ROLE OF EXTENSION IN POLLUTION ABATEMENT IN VIRGINIA,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Cooperative Extension Service.
R. L. Wesley.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971, The Airlie House, Warrenton, Virginia, p 169-171.

Descriptors: *Farm wastes, *Poultry, *Administrative agencies, Lagoons, Anaerobic digestion, *Waste treatment, Water reuse, *Virginia.

Cooperative Extension Service at Virginia Polytechnic Institute and State University is quite heavily involved in assisting the poultry industry in Virginia with pollution abatement. Areas of assistance with top priority include the design, construction, and operation of waste disposal systems for poultry processing and rendering plants, and conduction of on-campus short courses at VPI and SU on pollution abatement. Poultry processing waste is a suitable substrate for biological degradation by both aerobic and anaerobic bacteria. The effluent from processing plants contains the proper bacterial flora so that when subjected to adequate liquid-solid separation procedures, 80% to 95% BOD removal can be achieved with the use of a series of oxidation ponds or lagoons. A grease and grit trap, an anaerobic digester, an aerobic polishing lagoon, and/or a mechanical aerator are the necessary ingredients for reliable disposal. If human sewage is also involved, final effluent chlorination is sometimes required. Temperature and depth of the lagoon are two critical factors for effective decomposition. At 10, 20, and 30 degrees Centigrade, 32, 89, and 96 percent of the solids have been removed. Predominant bacteria that will appear in a lagoon are temperature dependent as evidenced by the various colors produced as the temperature changes occur. Additional processes will need to be added to the design in order for the treated effluent to be recycled. (Schmitt-Iowa State)

0618 - B1, F3

COMMUNICATION IS THE KEY TO SUCCESSFUL ACTION,
E. W. McMunn.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971, The Airlie House, Warrenton, Virginia, p 173-176.

Descriptors: *Farm wastes, *Communication, *Technology, Waste disposal, Pollution abatement, Political aspects, Education.

Developing new technology is important; but knowledge is of little value until it is put to use. And it will never be used unless it reaches the minds of those who need to know. We spend relatively little time studying how to communicate in an effective manner. Non-farm people are increasingly calling the tune where our vital interests are concerned, due to population shifts. These people no longer understand agriculture and many couldn't care less. Our job is to build understanding with non-farm people. Since the whole store of knowledge is incomprehensible, we must choose a few basic ideas and concentrate on these. Questions we must decide include, (1) What, really, is the message we wish to tell. (2) Why do we want to tell it. (3) Who do we want to reach. (4) Who should do the telling. (5) What 'vehicles' must be employed to transport our message. Something similar to a task force needs to make these decisions where people with a common interest unite to tell a story. This task force must represent a wide range of interests, be aware of human nature in planning communication strategy, plan communications programs on the basis of meaning to the people we're trying to reach, have a relevant message and then deliver it in terms the audience will understand. Certainly, the most important single element must be a communications plan. (Schmitt-Iowa State)

0619 - F4

REPORTS AND RECOMMENDATIONS OF WORKING GROUPS.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971, The Airlie House, Warrenton, Virginia, p 179-185.

Descriptors: *Farm wastes, *Administrative agencies, *Government supports, Economic feasibility, Pollution abatement.
Identifiers: Extension Service.

Six different subject categories were discussed by various working groups of the National Symposium on Animal Waste Management. Recommendations have been made for each subject category and are as follows: (1) Information Programs - A national agricultural-related pollution problem inventory should be funded and carried out through existing agencies; create a national data inventory bank on waste management research; establish a task force to develop a system for providing animal waste management information to farmers and to the public. (2) Education and Training Program - The Extension Service should receive additional resources and be more concerned with public affairs; formal education should be emphasized both in the private sector and in government agencies. (3) Technical Assistance - An advisory committee with some legal status should be established to advise legislators; livestock and poultry producers should form a common group to represent their interests. (4) Financial Assistance - Tax credits should be allowed for pollution abatement measures; relocation assistance should be available; cost-share programs should be expanded. (5) Research and Development - On-farm field research should be increased and supported financially. (6) Legislation and Regulation - Flexibility should be maintained. An ad hoc animal waste coordinating committee should be appointed in each state to improve cooperation among all groups and develop well-defined goals. (Schmitt- Iowa State)

0620 - F3

RECOMMENDATIONS OF NATIONAL MILK PRODUCERS FEDERATION.
In: Animal Waste Management: Proceedings of National Symposium on Animal Waste Management, September 28-30, 1971, The Airlie House, Warrenton, Virginia, p 187-188.

Descriptors: *Farm wastes, *Administrative agencies, *Government supports, Pollution abatement, Waste disposal, *Milk, *Dairy industry.
Identifiers: *Rural Environmental Assistance Program.

The regulation of individual livestock operations should be based on individual adherence to regional waste management guidelines. Regional guidelines should serve as national standards to be enforced at the state level through an appropriate state certification program. The development of regional guidelines should be predicated on the principle that an overall conservation plan is essential for the individual farm or ranch enterprise embarking on a pollution prevention program. It is essential that animal waste management guidelines become a part of a systematic approach to develop an overall conservation plan because of the interrelationship of waste utilization, recycling, or disposal, with overall farm operations, available soils and appropriate vegetation. Each waste management system must be tailored to the needs of individual owners or operators within the capability of soils and plant cover at the site. A contract arrangement between USDA and individuals is most effective in assisting farmers to comply with regional guidelines. An additional $200 million per year over current REAP funding should be appropriated for expenses of a program of research, financial and technical assistance to agricultural waste and pollution producing enterprises.
(Schmitt-Iowa State)

0621 - D2, E3, F1

POULTRY POLLUTION: RESEARCH RESULTS,
Michigan State Univ., East Lansing. Agricultural Experiment Station.
C. C. Sheppard.
Research Report 152 Farm Science, C.C. Sheppard, editor. 64 p. November, 1971.

Descriptors: *Farm wastes, *Odor, *Poultry, Nutrients, Diets, Fertilizer, *Waste disposal, Analysis.
Identifiers: *Dried Poultry waste, Air ventilation, Supplemental protein, Feed efficiency.

The drying and feeding of poultry waste was reviewed as to the economic value, nutrient value, and the effects on animals fed dried poultry manure. The topics include: (1) economics of dried poultry waste as a feed ingredient or a fertilizer, (2) feeding dehydrated poultry waste to dairy cows, (3) the relationship of drying temperature to total crude protein in dried poultry waste, (4) drying of poultry manure in a cage-layer house, (5) dried poultry waste as a protein source for feedlot cattle. (6) the metabolizeable energy value of dried poultry waste, and (7) the effects of continually recycling dehydrated poultry waste on the performance of SCWL laying hens. A table presents results of analyses of samples of dried poultry waste. (Bundy-Iowa State)

0622 - C3, C5, E3

EARLY EXPERIMENTS AT MICHIGAN STATE UNIVERSITY INVOLVING THE USE OF CHICKEN MANURE,
Michigan State Univ., East Lansing. Dept. of Poultry Science.
H. C. Zindel.
In: Poultry Pollution: Research Results, Michigan Agricultural Experiment Station, Research Report 152 Farm Science. November 1971. p 2-3.

Descriptors: *Farm wastes, *Poultry, Nutrients, Antibiotics, Diets, *Waste disposal.
Identifiers: Fresh chicken droppings, Oven dried.

The original poultry science research at Michigan State University involving the use of poultry excreta as a feed ingredient was performed in 1954. Drs. David Libby and P. J. Schaible used poultry manure in research involving antibiotics. They reported that under clean battery conditions, no response was obtained from the drug in the feed. However, when contaminated manure was in the ration, the furazotidone exhibited a pronounced growth response. In 1959, W. K. Warden and P. J. Schaible conducted a series of experiments in which fresh chick droppings were fed to chicks daily in the presence and absence of antibiotics. When fecal matter was fed to chicks, growth rate was depressed below that of the controls, but this depression was not statistically significant. In 1961, J. D. Yates reported that fresh hen feces added to the feed of chicks and poults depressed growth, except in some groups which received a high level of antibiotics. Heated (100 Deg C) fresh hen feces improved the growth rate of chicks which received no antibiotics and turkey poults which received Virgeniamycin in the ration. (Bundy-Iowa State)

0623 - E3, F1

ECONOMICS OF DRIED POULTRY WASTE (DPW) AS A FEED INGREDIENT OR A FERTILIZER,
Michigan State Univ., East Lansing. Dept. of Poultry Science.
H. C. Zindel, and C. J. Flegal.
In: Poultry Pollution: Research Results, Michigan Agricultural Experiment Station, Research Report 152 Farm Science, November, 1971. p 4-7.

Descriptors: *Farm wastes, *Odor, Drying, Poultry, Fertilizer, *Waste disposal.
Identifiers: *Hens, Tractor and spreader, Dried poultry waste, Recycling.

Several laying hen trials have been conducted using dried poultry waste (DPW) in the diet. If 12.5% or 25% DPW of the total ration were substituted for the same amount of corn on a pound for pound basis, basing the cost of corn at $60 per ton and DPW at $20 per ton, a direct saving of either $5.00 or $10.00 per ton can be realized, respectively. Translating this into savings per dozen eggs, a one cent per dozen eggs savings would be accomplished for 12.5% DPW and a two cents per dozen eggs savings on 25% DPW. Manure disposal via the conventional method of spreading on crop land versus that of drying provides some interesting facts and figures. A flock of 100,000 layers provides 4,563 tons of manure per year (at the rate of .25 lb./bird/day) or 12.5 tons daily. If one assumed it takes 2 days or 16 hr. to clean the house (s) each month (4 week period) and deliver the wet manure to the field for spreading with a tractor and spreader, or deliver to a dryer site for processing, the following facts apply: wet manure value for fertilizer: $2.39 ton; cost of spreading wet manure: $11.96 tons. Difference of $9.57 /ton is the loss to spread on the land. (Bundy-Iowa State)

0624 - E3

FEEDING DEHYDRATED POULTRY WASTE TO DAIRY COWS,
Michigan State Univ., East Lansing. Dept. of Dairy Science.
J. W. Thomas, and H. C. Zindel.
In: Poulty Pollution: Research Results, Michigan Agricultural Experiment Station, Research Report 152 Farm Science, November, 1971. p 8-11, 2 tab, 4 ref.

Descriptors: *Farm wastes, *Poultry, Cattle, Drying, Amino acids, Nitrogen, Protein, *Waste disposal.
Identifiers: Laying hens, Dairy cattle, Dehydrated poultry waste, Milk quality.

Investigators have found that several classes of livestock could derive energy and nitrogen from various animal manures. The digestive system of the ruminant can convert various non-protein-nitrogen sources into amino acids that are useful to the animal. Of the nitrogen in poultry manure, 25 to 75% may be in various non-protein-nitrogen forms. This non-protein-nitrogen in poultry

manure may slowly hydrolyze in the rumen and form a very good source of N for ruminants. Dehydrated caged layer feces was fed to milking dairy cows to determine if it could serve as a nitrogen energy source. Consumption of the grain mixture containing 30% dehydrated poultry waste (DPW) was as great as that of cows fed normal grain mixtures after the cows became accustomed to the material. The flavor of the milk from DPW fed cows was scored normal. Dehydrated caged layer feces was successfully used to furnish a portion of the dietary protein and energy in the diet of milking cows. Thus, products similar to that used here could replace 15 to 20% of the dietary protein of ruminants. (Bundy-Iowa State)

0625 - C3, D2

THE RELATIONSHIP OF DRYING TEMPERATURE TO TOTAL CRUDE PROTEIN IN DRIED POULTRY WASTE,
Michigan State Univ., East Lansing. Dept. of Poultry Science.
C. C. Sheppard, C. J. Flegal, D. Dorn, and J. L. Dale.
In: Poultry Pollution: Research Results, Michigan Agricultural Experiment Station, Research Report 152 Farm Science, November, 1971. p 12-16, 1 fig, 2 tab, 3 ref.

Descriptors: *Farm wastes, *Drying, Protein, Poultry, Feces, *Waste disposal.
Identifiers: Dried poultry waste, Commercial dryer.

Benne from Michigan State University reported laboratory analysis of 77 samples of poultry feces. Fourteen of these were analyzed as a wet product (as received from a poultry house) and 63 had been dried in a commercial dryer, prior to the analysis. The extreme variations in total protein on a dry weight basis of the wet and dried samples are given. The relationship between the temperature at which the feces was dried and the resulting total protein content of the dried poultry waste was investigated. The regression analysis of the data shows there tends to be an inverse relationship between the heat and the resulting total protein. The correlation of drying temperature to the resulting total protein approaches significance. The calculated coefficient was -0.284; -0.288 would indicate significance at the P = .05 level. (Bundy-Iowa State)

0626 - A5, A6, B1, D2

DRYING OF POULTRY MANURE IN A CAGE-LAYER HOUSE,
Michigan State Univ., East Lansing, Dept. of Agricultural Engineering.
M. L. Esmay, and C. C. Sheppard.
In: Poultry Pollution: Research Results, Michigan Agricultural Experiment Station, Research Report 152 Farm Science, November, 1971. p 17-27, 2 fig, 3 tab.

Descriptors: *Farm wastes, *Odor, *Poultry, *Drying, Environment, Air pollution, *Waste disposal.
Identifiers: Partial drying, Cage-laying house, Air ventilation.

Odor control is important for today's poultry enterprises. Partial drying of the poultry excreta within a few hours after deposit is one way to minimize odor production and thus air pollution. This investigation deals with the means and related economics of partially drying fecal matter in the poultry house with supplemental electrical energy. Over 2000 Btu of electrical energy were required to evaporate each additional pound of water from the fecal matter accumulated over the energized dropping pit panels. This is less than 50% efficient use of electrical energy applied to the floor panels below the cages. The cost was about one cent per additional pound of water evaporated from the droppings, (1 kwh equals .3420 Btu/hr and each kwh costs between 1.5 to 2.0 cents). Removing additional water from the droppings during winter months may not be worth the cost, unless the undesirable threshold is imminent and dwellings are near by. During hot weather conditions, removing part of the fecal matter moisture immediately after depositcould be critical in controlling odors. High temperatures accelerate odor production; and hot weather vaporization with energized panels could be much more efficient in utilizing electrical heat. (Bundy-Iowa State)

0627 - E3

DRIED POULTRY WASTE AS A PROTEIN SOURCE FOR FEEDLOT CATTLE,
Michigan State Univ., East Lansing. Dept. of Animal Husbandry.
H. F. Bucholtz, H. E. Henderson, C. J. Flegal, and H. C. Zindel.
In: Poultry Pollution: Research Results, Michigan Agricultural Experiment Station, Research Report 152 Farm Science, November, 1971. p 28-31, 2 tab.

Descriptors: *Farm waste, *Poultry, Drying, *Cattle, Nutrient, Protein, *Waste disposal, Efficiency.
Identifiers: Dried poultry waste, Feedlot cattle, Supplemental protein, Feed efficiency.

Waste disposal in animal agriculture has become not only a management problem, but also an environmental pollution concern to people associated with the animal industries. The poultry industry tried to dry poultry waste to abate the waste disposal problem. Due to the high protein content of fresh poultry waste (as high as 50% CP), research was conducted using dried poultry waste (DPW) as a protein supplement for chickens and cattle. However, data on recycling DPW through cattle is limited. The value of DPW as a supplemental protein source for feedlot cattle was determined. The source of protein had a large and highly significant effect on average daily gain. Average daily gain for the soy supplemented group (3.35 lb) was significantly greater than the group supplemented with DPW (2.75 lb), 1/2 DPW - 1/2 urea (3.03 lb). However, this was not significantly greater than the urea supplemented group (3.10 lb). No significant differences in average daily gain occurred between the groups supplemented with urea, 1/2 DPW - 1/2 soy or 1/2 DPW - 1/2 urea. Steers refused to consume the DPW portion of ration. (Bundy-Iowa State)

0628 - C3, E3

THE METABOLIZEABLE ENERGY VALUE OF DRIED POULTRY WASTE,
Michigan State Univ., East Lansing. Dept. of Poultry Science.
D. Polin, S. Varghese, M. Neff, M. Gomez, and C. J. Flegal.
In: Poultry Pollution: Michigan Agricultural Experiment Station, Research Results, Research Report 152 Farm Science, November 1971. p 32-44, 1 fig, 5 tab, 15 ref.

Descriptors: *Farm wastes, Drying, *Dehydration, Poultry, Nutrients, Nitrogen, Diets, *Waste disposal.
Identifiers: *Dried poultry waste, *Metabolizeable energy.

Metabolizeable energy (M.E.) values of 0.35 and 1.35 kcal/g (159 and 614 kcal/lb) of material were found for cellulose and a dried poultry waste (DPW) sample, respectively, when fed to laying hens. The materials were analyzed for M.E. by replacing corn in a practical type layer ration at levels of 8 and 16%. The calories returned to the diet by either DPW or cellulose were determined and compared on the basis of slope ratios to the expected loss caused by the removal of corn. Cellulose at both levels depressed protein, as well as calcium and phosphorus utilization. Protein utilization was not affected by DPW and neither DPW nor cellulose had any effect on the utilization of fat, which averaged almost 90% with all test diets. (Bundy-Iowa State)

0629 - B1, E3

THE EFFECTS OF CONTINUALLY RECYCLING DEHYDRATED POULTRY WASTES (DPW) ON THE PERFORMANCE OF SCWL LAYING HENS – A PRELIMINARY REPORT,
Michigan State Univ., East Lansing. Dept. of Poultry Science.
C. J. Flegal, and D. A. Dorn.
In: Poultry Pollution: Research Results, Michigan Agricultural Experiment Station, Research Report 152 Farm Science, p 45-48, November 1971. 3 tab, 2 ref.

Descriptors: *Farm wastes, Poultry, Drying, Nutrients, Diets, *Dehydration, *Waste disposal.
Identifiers: *Dried poultry waste, Dehydrated feces.

An ultimate goal in poultry production is a closed circuit system in which the only by-product of the system is meat or eggs. The following experiment was conducted to test the concept or recycling the feces within a closed system of egg production for an extended period. Five hundred and eighty-eight commercially grown 20-week-old started pullets were fed diets containing 0, 12.5%, and 25.0% DPW for about 7 mo. The DPW diets were continually recycled, i.e., feed feces dehydrated and placed back in the diets and fed to the same birds in a closed system concept. At the completion of fourteen cycles, the proximate analysis of the DPW from each of the experimental rations was quite similar. There was a trend toward a slight accumulation of calcium and phosphorus. Egg production for the birds fed the control diet and the diet containing 12.5% DPW were similar. Daily feed consumption of the birds fed the control diet and the diet containing 12.5% DPW was similar, but those birds fed the diet containing 25% DPW ate 11.3 g more feed per bird per day than those fed the control diet. (Bundy- Iowa State)

0630 — C2, C3, E3

A COMPILATION OF SOME SAMPLES OF DRIED POULTRY WASTE ANALYZED BY DR. E. J. BENNE,
Michigan State University, Biochemistry Dept., East Lansing, Michigan.
E. J. Benne.
Poultry Pollution: Research Results, Research Report 152 Farm Science, Michigan State University Agricultural Experiment Station, East Lansing, Michigan. November, 1971. pp. 49-63, 1 tab.

Descriptors: *Farm Waste, *Analysis, Poultry, Protein, Dehydration, Moisture content, Calcium, Phosphorus.
Identifiers: *Dried Poultry Waste.

The author compiled data collected from samples of dried poultry waste. A laboratory analysis of 77 samples of poultry feces including 14 samples analysed as a wet product and 63 had been dried in a commercial dryer. The article consists of the one tbale with percents of moisture, protein, PDWB, CA, P, Crude F, EE and NPN. (Bundy - ISU).

0631 - A5, A6, C3, D1

ODORS, GASES AND PARTICULATE MATTER FROM HIGH DENSITY POULTRY MANAGEMENT SYSTEMS AS THEY RELATE TO AIR POLLUTION,
Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
A. T. Sobel, D. C. Ludington, A. G. Hashimoto, W. E. Burnett, and N. C. Dondero.
Final Report, New York State Dept. of Health, Division of Air Resources, Ithaca, New York, April 15, 1969. 106 p, 29 fig, 16 tab, 73 ref.

Descriptors: *Farm wastes, *Poultry, *Odor, *Gases, Ammonia, Hydrogen sulfide, Gas chromatography, Carbon dioxide, Moisture content, Organic compounds, *Air pollution.
Identifiers: *Particulate matter, Soil columns, Odor panel, Soil filtration, *Odor control.

The technological changes which have taken place in livestock production in the last few years to provide economical meat, eggs, and milk have resulted in the concentration of animals under conditions of high density for greater efficiency. This change of management practice has created problems in both waste disposal and the control of odors from these wastes. These odors are particularly obnoxious when either the animal enterprise or the land for disposal of manure is adjecent to urban or resort developments. Results of a two year research project dealing with the detection and control of air pollution from high density poultry management systems are summarized. It covers such subjects as the determination of the chemical nature of the odor of poultry manure; the quantitative determination of odors and gases from poultry manure; the role of particulate matter in air pollution; and odor control methods such as soil filtration, water scrubbing, and chemical treatment. (Bundy-Iowa State)

0632 - A5, C3

THE QUALITATIVE DETERMINATION OF THE ODOR QUALITY OF CHICKEN MANURE,
Cornell Univ., Ithaca, N.Y. Dept. of Food Science.
W. E. Burnett.
In: Odors, Gases and Particulate Matter from High Density Poultry Management Systems as They Relate to Air Pollution. Final Report, New York State Dept. of Health, Division of Air Resources, Ithaca, New York, p 2-17, April 15, 1969. 6 fig, 2 tab, 18 ref.

Descriptors: *Farm wastes, *Odor, *Poultry, Gas chromatography, Nitrogen, Ammonia, Hydrogen sulfide, Organic compounds, *Air pollution.
Identifiers: Odor panel, Organoleptic techniques, Liquid poultry manure, Odorous organic compounds.

A combination of gas chromatographic and organoleptic techniques was used to determine the chemical compounds responsible for the offensive odor of accumulated liquid poultry manure. In addition to the odorous gases, ammonia and hydrogen sulfide, a number of odorous organic compounds were identified, including the C2 to C5 organic acids, indole, skatole, diketones, mercaptans, and sulfides. Of these, organoleptic tests indicate that the organic acids, mercaptans, and sulfides were important malodorous components. Skatole was also implicated as an important malodorous component, due to its characteristic strong, fecal odor. Amines evidently play an important role in the odor as well.
(Bundy-Iowa State)

0633 - A5, B1, C3

THE QUANTITATIVE DETERMINATION OF THE ODOR STRENGTH OF CHICKEN MANURE,
Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
A. T. Sobel, and W. E. Burnett.
In: Odors, Gases and Particulate Matter from High Density Poultry Management Systems as They Relate to Air Pollution. Final Report, New York State Dept. of Health, Division of Air Resources, Ithaca, New York, p 18-39, April 15, 1969. 5 fig, 3 tab, 12 ref.

Descriptors: *Farm wastes, *Odor, Waste dilution, Poultry, Ammonia, Moisture content, *Air pollution.
Identifiers: *Vapor dilution, *Liquid dilution, Manure strength, Cage-laying hens, Olfactory threshold test, Fresh manure.

Strength is a characteristic of an odor that can be measured. In contrast to characteristics such as quality and occurrence which rely only on individual opinion, strength allows associating a number with an odor. The method of liquid dilution and the method of vapor dilution have been investigated. Odor strength of animal manures can be measured on a laboratory basis by the liquid dilution and the vapor dilution methods. The vapor dilution method looks at the odors arising from the manure while the liquid dilution method is concerned with the odors in the manure or the odor potential of the manure. Odor was found to have a higher strength from mixed manure than from unmixed manure. Odors arising from diluted or 'liquid' manure have an odor strength comparable with the odors arising from undiluted manure. However, the quality of the odor from 'liquid' manure is very offensive compared with the ammonia-like odor from undiluted manure. Reduction in the moisture content of manure reduces the odor strength and the odor offensiveness. The odor strength for fresh manure by liquid dilution is a dilution of the order 1000. This value can increase to as high as 35,000 depending on conditions. Odor strength measurements by vapor dilution are only valuable for comparison purposes, since odor production flow rates are unknown values. (Bundy-Iowa State)

0634 - A6, C3

ANALYSES OF GASES ENCOUNTERED IN A COMMERCIAL POULTRY HOUSE,
Cornell Univ., Ithaca, N.Y. Dept. of Food Science.
W. E. Burnett.
In: Odors, Gases and Particulate Matter from High Density Poultry Management Systems as They Relate to Air Pollution. Final Report, New York State Dept. of Health, Division of Air Resources, Ithaca, New York, p 40-46, April 15, 1969. 1 tab, 30 ref.

Descriptors: *Farm wastes, *Poultry, Ammonia, Carbon dioxide, Hydrogen sulfide, Organic compounds, Odor, Air pollution, Sufur dioxide, Humidity, Temperature, *Air pollution.
Identifiers: Chemical detection.

Little is known about the concentration of gases in poultry houses. Past research has centered mainly on the ammonia and carbon dioxide levels in poultry confinement housing. Ammonia concentrations as high as 100 ppm have been found in some commercial poultry houses under the conditions of reduced ventilation and reuse of litter. Some factors which are believed to affect the concentration of gases in poultry buildings are temperature, humidity, ventilation, bird population and the manure management system, as well as frequency of waste removal. A number of existing techniques for the measurement of industrial air pollution are applicable to the analysis of gases encountered in commercial poultry houses. The wet chemical (absorption) method of gas detection was used to determine the concentrations of aliphatic aldehydes, hydrogen sulfide, sulfur dioxide and ammonia in a commercial poultry house with fluid waste handling. The average gas concentrations in ppm were 0.032, 6.98, 0.0036, and 1.13 for aliphatic aldehydes, hydrogen sulfide, sulfur dioxide, and ammonia respectively. None of the gas concentrations were above the maximum allowable concentration (MAC) for humans, but the level of H2S was well above its odor threshold of 0.13 ppm. As the concentrations of gases showed considerable variation from sampling to sampling, more work is needed to correlate gas concentrations with such factors as temperature, ventilation rate and manure management system.
(Bundy-Iowa State)

0635 - A5, A6, C3

GASES AND ODORS FROM UNDILUTED AND DILUTED CHICKEN MANURE,
Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
D. C. Ludington, A. T. Sobel, and A. G. Hashimoto.
In: Odors, Gases and Particulate Matter from High Density Poultry Management Systems as They Relate to Air Pollution. Final Report, New York State Dept. of Health, Division of Air Resources, Ithaca, New York, p 47-64, April 15, 1969. 10 fig, 5 ref.

Descriptors: Farm wastes, Poultry, Odor, Carbon dioxide, Methane, Ammonia, Hydrogen sulfide, Waste dilution, *Air pollution.
Identifiers: Odor strength.

The odors and gases produced by and released from chicken manure stored and handled in the undiluted and diluted state have been observed to be considerably different. This difference was most obvious when the stored manure was being moved or agitated. More cases of air pollution attributed to egg producing poultry farms have been reported since the diluted system of storage and handling was put into practice. The release of some of the gases and odors from stored chicken manure under the undiluted and diluted state was investigated. Significant differences occurred between the odor and gas production and release by undiluted and diluted chicken manure. Carbon dioxide release from the undiluted manure was slightly greater than the release from diluted manure. The difference may not be significant. The undiluted system released significantly greater quantities of NH3 than the diluted system. Chicken manure stored in a diluted state produced significantly more H2S and NH3 than manure stored in an undiluted state. The release of H2S from the diluted system was about twice that released from the undiluted manure. Both releases were well below threshold. The odor released from the diluted manure, while the manure was quiescent, was in general, more obnoxious than that from the undiluted manure. When the manure was agitated at the end of the tests, the difference was much more pronounced. (Bundy-Iowa State)

0636 - A5, A6, C3

PARTICULATE MATTER,
Cornell Univ., Ithaca, N.Y. Dept. of Food Science.
W. E. Burnett.
In: Odors, Gases and Particulate Matter from High Density Poultry Management Systems as they Relate to Air Pollution. Final Report, New York State Dept. of Health, Division of Air Resources, Ithaca, New York, p 65-70, April 15, 1969. 1 tab, 10 ref.

Descriptors: *Farm wastes, *Odor, *Poultry, Gas chromatography, Circulation, *Air pollution.
Identifiers: Odor panel, *Particulate matter, Filter pads, Poultry dust.

Modern commercial high density poultry houses contain high concentrations of airborne particulate matter. Concentrations as high as 1.16 mg per cubic foot of air have been reported. Regarding quantities of particulates produced, amounts as high as 1 lb/day/1000 birds have been reported. The particulate matter consists of fecal matter, feed, feathers, and epidermal fragments, litter, and dust brought into the poultry house by the ventilation system. Particulate matter collected by high volume samplings of a commercial poultry house atmosphere revealed that the particulates carried a 'chicken house' odor. Gas chromatographic analyses of the volatiles carried by the particulates revealed the presence of individually odoriferous compounds. Large quantities of particulate matter are probably expelled from poultry houses by ventilation fans. Whether particulate matter plays a significant role in ambient odors from poultry houses should be investigated further since the particulates represent a retentive source of odors. (Bundy-Iowa State)

0637 - A5, C3, D2

SOIL FILTRATION TO REMOVE ODORS,

Cornell Univ., Ithaca, N.Y. Dept. of Food Science.
W. E. Burnett, and N. C. Dondero.
In: Odors, Gases and Particulate Matter from High Density Poultry Management Systems as They Relate to Air Pollution. Final Report, New York State Dept. of Health, Division of Air Resources, Ithaca, New York, p 71-86, April 15, 1969. 3 fig, 8 tab, 14 ref.

Descriptors: *Farm wastes, Odor, Organic compounds, Poultry, Soil, Ammonia, Hydrogen sulfide, Filtration, *Waste treatment, *Air pollution.
Identifiers: *Soil filtration, Soil columns, Liquid dilution method, Odor panel, *Odor control.

Modern, high-density poultry operations in which there are accumulations of manure cause nuisances in populated areas because of the foul odors discharged to the atmosphere by forced ventilation. The feasibility of removing poultry odors from ventilation air by soil filtration was investigated. The soil column effectively removed manure odors. Odors were removed by only 6 inches of soil under the conditions of test. The ability of the soil to remove ammonia decreased markedly as the soil dried. Soil columns remove ammonia as long as the soil remains moist. Ammonia breaks through those columns when dry. The manured soil removed more ammonia than the untreated soil. (Bundy-Iowa State)

0638 - A5, B1, D1, D3, E1

ODOR CONTROLS BY CHEMICAL TREATMENT,

Cornell Univ., Ithaca, N.Y. Dept. of Food Sciences.
W. E. Burnett, and B. Gormel.
In: Odors, Gases and Particulate Matter from High Density Poultry Management Systems as They Relate to Air Pollution. Final Report, New York State Dept. of Health, Division of Air Resources, Ithaca, New York, p 87-97, April 15, 1969. 5 fig, 1 tab, 12 ref.

Descriptors: *Farm wastes, *Odor, Poultry, Ammonia, Hydrogen sulfide, Carbon dioxide, *Waste treatment, *Air pollution.
Identifiers: *Chemical treatment, Mechanical control, *Odor control.

The various methods of odor control include elimination by mechanical, physical, or chemical means, and modification, usually by chemical means. Chemical means was reviewed in an attempt to eliminate or modify poultry manure odors. The emphasis is on abatement of odor from liquid management systems. Offensive manure odors can be effectively masked by the use of an effective masking agent dispersed in Mosquito Larvae Oil in liquid poultry manure pits. Mosquito Larvae Oil appears to do an effective job in dispersing the masking agent over the surface of the liquid manure. Applications of 5 ml and 10 ml of making agent to the tanks of liquid manure were considered to be impractical because of the relatively short time these additions were effective in masking the odors, especially after the proportion of manure solids increased in the water.
(Bundy-Iowa State)

0639 - A4, B2, C5, E2

USING SOIL FILTRATION TO REDUCE POLLUTION POTENTIAL OF LAGOON EFFLUENT ENTERING GROUND WATER SYSTEM,

Iowa State Univ., Ames.
C. E. Beer, and J. K. Koelliker.
Iowa State Water Resources Research Institute, Ames, Completion Report ISWRRI-41, August, 1971. 32 p, 4 fig, 2 tab, 23 ref. OWRR A-021-IA (1).

Descriptors: *Irrigation efficiency, *Denitrification, *Nitrogen, *Farm wastes, Chemical oxygen demand, *Nitrates, Ammonia, *Lagoons, Waste treatment, *Waste disposal, Anaerobic conditions, *Waste water treatment, Application, *Effluents, Iowa, Biochemical oxygen demand, Chemical oxygen demand, *Phosphorous, Organic matter, *Filtration, Infiltration, *Soil profiles, Sprinkling
Identifiers: *Soil filtration.

Swine lagoon effluent was applied to soil for final treatment. The active soil profile appears to offer great potential as a final treatment media for partly treated animal wastes and cattle feedlot runoff. Effluent sprinkled on a grass-covered soil profile reduced COD, nitrogen, and phosphorus concentrations 79-95, 40-80, 95-99 percent, respectively over a 3-year period. Loadings ranged from 13.9 to 48.1 in. of lagoon effluent per May-October season. Removal of COD was attributed to biological activity and physical filtration in the upper inches of the soil. Phosphorus reduction resulted from chemical activity of the clay fraction near the soil surface. Nitrogen reduction was attributed primarily to denitrification deeper in the soil profile. The organic matter in the soil served as the carbon source for denitrification rather than the lagoon effluent. Organic matter content of the lower region of the soil profile was reduced and nitrogen removal by denitrification decreased. For disposal fields that are operated primarily for BOD removal, about 24 in. per year can be applied in most areas of Iowa. In areas where nitrate concentration in the percolate is of concern, applications should be limited to 600 lb/acre of nitrogen per season.

0640 - A2, A4, F2, F3

HANDLING LIVESTOCK WASTE,

North Dakota State Univ., Fargo. Dept. of Agricultural Engineering and Animal Science.
G. L. Pratt, D. W. Johnson, and M. L. Buchanan.
North Dakota Farm Research, North Dakota State University Reports on Environmental Quality, Vol 4, No 28, p 22-24, March-April, 1971. 1 tab.

Descriptors: *Farm wastes, *Treatment, *Water quality control, Oxidation lagoons, Aeration, Disposal, Drying, Farm lagoons, Filtration, Dewatering, Separation techniques, Waste storage, Confinement pens, Settling basins, Runoff.
Identifiers: *Groundwater pollution, Feedlots, Slatted floors.

Congress has been developing legislation since 1948 to prevent water pollution. The Federal Water Quality Act of 1965 was the culmination of this development. The act provided that states could set water quality standards and administer them. In 1967 the North Dakota legislature adopted a comprehensive water pollution control act. These acts have necessitated research on managing and disposing of livestock wastes. The major phases of manure handling are collection, storage, treatment, and disposal. Various methods of collection, storage, treatment, and disposal are listed with their relative advantages and disadvantages. However, spreading on cropland has been the standard method to dispose of livestock manure for a long time. Research to date indicated that it is still the most practical method for preventing pollution. (Dorland-Iowa State)

0641 - A3, C4

BACTERIAL COUNTS OF A SECTION OF THE RED RIVER -- SUMMER, 1970,

North Dakota State Univ., Fargo. Dept. of Bacteriology.
M. C. Bromel.
North Dakota Farm Research, North Dakota University Reports on Environmental Quality, Vol 4, No 28, p 60-61, March-April, 1971.

Descriptors: *Water pollution, *Coliforms, *Waste dilution, North Dakota, Cultures, Oxygen demand, Treatment facilities, Salmonella, Clostridium, Shigella, Fishkill.
Identifiers: *Red River, Bacteriological analyses, Coliform count.

Numerous surveys by state and federal agencies from 1935-1969 indicate that the Red River has become progressively more polluted as the municipal and industrial population along its banks increase. During the summer of 1970, from June 8 through July 28 an intensive biological and bacteriological survey of the Red River was undertaken. Surface and bottom water samples were collected from a boat with a Van Dorn water sampler. Biological and chemical analysis on each sample included the following determinations: dissolved oxygen, pollution, number of animals sensitive to pollution, and total suspended solids. The bacterial counts, especially the coliform counts, were far over the 5,000/100 ml allowable by North Dakota and Minnesota standards for potable or recreational water. There was consistently present a high concentration of bacteria in the Red River at the Fargo intake averaging 500,000 bacteria per milliliter of water. The dissolved oxygen level at several sites was below the two-state standard (5 ppm) minimum. The presence of Shigella dysenteriae in the Wild Rice River when the coliform count was very low (500/ml) is remarkable since this form of Shigella is very rarely found in the U.S. (Dorland-Iowa State)

0642 - F4

AGRICULTURAL WASTES: PRINCIPLES AND GUIDELINES FOR PRACTICAL SOLUTIONS.

New York State Coll. of Agriculture, Ithaca.

Cornell University Conference on Agricultural Waste Management, February 10-12, 1971, Syracuse, New York. 172 p.

Descriptors: *Farm waste, *Water quality control, Pesticides, Eutrophication, Liquid waste, Surface runoff, Dehydration, *Waste water treatment, Oxidation lagoons, Incineration.
Identifiers: Composting, Land spreading.

The purpose of this 1971 Conference was to take the knowledge obtained from research and field experience and convert this knowledge into information which can be used to solve the problems in agricultural waste management. Another benefit of this proceedings may be to point out areas where the information is weak or missing. This could be helpful in planning more appropriate research in the future. (Bundy-Iowa State)

0643 - A3, F3

AGRICULTURE:S RESPONSIBILITIES IN A CLEAN ENVIRONMENT,

New York State Dept. of Environmental Conservation, Albany.
R. W. Pederson.
In: Agricultural Wastes: Principles and Guidelines for Practical Solutions, Cornell University Conference on Agricultural Waste Management, February 10-12, 1971, Syracuse, New York, p 1-5.

Descriptors: *Farm wastes, *Pollution abatement, *Pesticides, *Water law ecosystems, Contaminants, Water quality control.

Agriculture's responsibilities in the all-out effort to achieve and maintain a clean environment are to recognize and understand its relationahips to other facets of the economy, to seek still greater knowledge on the 'hows' of waste management, and to apply the principles and guidelines that lead to practical solutions. Agriculture is an interlocked part of our society and culture, and our environmental problems are becoming more severe very rapidly. The new New York Department of Environmental Conservation has set goals of achieving greater effectiveness in correcting yesterday's costly mistakes, and of preventing the future degradation of our environment. Effective steps in pollution prevention mean a substantial commitment of manpower and financial resources, individual and corporate investments that aren't immediately profitable, new attitudes, and environmental conscience, and more government controls. The Department of Environmental Conservation's activities can affect land use by pesticide controls, by water supply and sewage controls for new subdivisions, controls over stream alteration, and controls over industrial plant location through permit issuance for water discharges and licensing of new air emissions. The total ecological system is very delicately interwoven and such things as the domino effect of DDT poisoning can be a very real threat to our ecology. (Schmitt-Iowa State)

0644 - A3, F3

ENVIRONMENTAL QUALITY AND PRODUCTIVITY,
Environmental Protection Agency, Washington, D.C. Water Quality Office.
J. D. Denit.
In: Agricultural Wastes: Principles and Guidelines for Practical Solutions, Cornell University Conference on Agricultural Waste Management, February 10-12, 1971, Syracuse, New York. p 6-11, 2 tab, 5 ref.

Descriptors: *Farm wastes, *Water quality control, *Surface runoff, Lagoons, Eutrophication, Water pollution sources, Water law.

World needs demand expansion of the already immense American livestock industry. The problem which now confronts the industry is the adverse impact of production wastes on the environment, particularly water quality. Due to the fragmented nature of earlier studies, a definite pattern of animal waste pollution has emerged only in the last two years. Fish kills from feedlot-runoff in Kansas in 1964 was an indicator of the twenty-four kills in twelve states in 1969. The combination of production oriented and traditional zero-cost, waste management philosophies is now leading to severe pollution problems. Anaerobic lagoons are designed on raw waste strength instead of runoff quality. Farmers have not been informed of state Water Quality Standards or their responsibility in meeting them. Even though organic waste loads from lagoons are higher than raw domestic wastes, the concentrations of nitrogen and phosphorus are of greater significance, because no industry is more dependent upon a pure water supply than agriculture. In conserving water quality, the agricultural operator is engaging in notable self-service and making an investment in survival.
(Schmitt-Iowa State)

0645 - A3, A7, F4

PESTICIDES AND PEST CONTROL IN THE FUTURE,
Cornell Univ., Ithaca, N.Y. Dept. of Entomology.
D. Pimentel.
In: Agricultural Wastes: Principles and Guidelines for Practical Solutions, Cornell University Conference on Agricultural Waste Management, February 10-12, 1971, Syracuse, New York. p 12-14, 1 ref.

Descriptors: *Farm wastes, *Pesticides, *Agricultural chemicals, *Pest control, Ecosystems, Water quality control, Regulation.

One billion pounds of pesticides were applied in the U.S. during 1970. Seventy percent was for farm use and the remaining for public and governmental use. Ninety-nine percent of the 200,000 species of plants and animals were non-target species, but many of these were affected. The Environmental Protection Agency has taken over the responsibility of pesticide regulation from the Dept. of Agriculture. In 1965, the overall return for every dollar invested in insect control with pesticides was 4 to 5 dollars, while the return per dollar invested in bioenvironmental control was 30 dollars. Development research in bioenvironmental control is slow, tedious, and costly. Prescription use of pesticides could have the advantages of expert advice, rapid distribution of new information from government agencies, more accurate control of the amounts used, and the establishment of a precautionary public attitude. Some pesticides would be banned and some applied only by state-licensed custom sprayers. Aware of the insidious destruction by pollution, the aim would be to keep the advantage of technology, but reduce the associated environmental hazards.
(Schmitt-Iowa State)

0646 - A3, C3

FARM LAND RUNOFF,
Cornell Univ., Ithaca, N.Y. Dept. of Natural Resources.
R. T. Oglesby.
In: Agricultural Wastes: Principles and Guidelines for Practical Solutions, Cornell University Conference on Agricultural Waste Management, February 10-12, 1971, Syracuse, New York. p 15-19, 11 ref.

Descriptors: *Farm wastes, *Runoff, *Nitrogen compounds, *Phosphorus compounds, Fertilizers, Water quality, Eutrophication, Soil erosion, Water pollution sources.

Agricultural wastes and many materials in agricultural usage are translocated to aquatic systems where some of them cause significant problems. Nitrogen, applied as fertilizer or from manures, leaks from agricultural activities in quantitites sufficient to promote nuisance algal growth in receiving waters where this element is a limiting factor, and many, through accumulation in groundwaters, constitute a health hazard as well. Large quantities of phosphorous are lost in runoff, primarily through erosion of soil-phosphorus particles. The significance of this form of phosphorus in stimulating algal growth is not fully understood but is probably not high. Organically bound phosphorus, such as that occurring in animal wastes, may add significant amounts of this element in a form available to plants. (Schmitt- Iowa State)

0647 - C5, F5

ENVIRONMENTAL PROBLEMS IN THE FOOD PROCESSING INDUSTRY,
Cornell Univ., Ithaca, N.Y. Agricultural Experiment Station.
D. L. Downing.
In: Agricultural Wastes: Principles and Guidelines for Practical Solutions, Cornell University Conference on Agricultural Waste Management, February 10-12, 1971. p 20-24, 6 tab.

Descriptors: *Farm wastes, *Water pollution sources, *Liquid wastes, Waste water disposal, Industrial wastes, Air pollution.

The food processing industry ranks fifth in the U.S. in the volume of liquid wastes generated, producing about 700 billion gallons annually. This waste contains a high amount of suspended solids of which only part is settleable; therefore, the national food industry ranks first in the amount of suspended solids released to the environment. The BOD5 of food-plant effluent is normally several thousand ppm compared with a few hundred for typical municipal sewage. The pH of food processing wastes range from below 5.0 for sulphur dioxide bleaching processes to about 12.0 for lye peeling of vegetables. Pigments in cannery wastes are very difficult to degrade, often persisting after passing through a municipal treatment plant. Olive, pickle and sauerkraut brine range up to 15% in sodium chloride content. Unlike some industries where waste products can be utilized, most solid wastes from canneries have to be hauled to land-fill type operations. Transmission of plant pathogens is a major reason wastes are not normally spread on the cropland. Adding to the waste problem is the fact that the food industry uses about 50% of all package utilization. Air pollution and noise pollution are still other problems it will take much ingenuity to solve.
(Schmitt-Iowa State)

0648 - A3, B1, F5

FERTILIZER PRACTICES WHICH MINIMIZE NUTRIENT LOSS,
Cornell Univ., Ithaca, N.Y. Dept. of Agronomy.
D. J. Lathwell, W. S. Reid, and D. R. Bouldin.
In: Agricultural Wastes: Principles and Guidelines for Practical Solutions, Cornell University Conference on Agricultural Waste Management, February 10-12, Syracuse, New York. p 25-35, 6 fig, 2 tab, 8 ref.

Descriptors: *Farm wastes, *Fertilization, *Nutrient requirements, Water pollution sources, Crop response, Rates of application, Soil erosion.

Water is the transport agent for nutrients, organic matter, and sediments from agricultural land. The major flow of runoff occurs in the spring when accumulated snow and ice melt. Experimental data demonstrate that the major quantity of nutrient loss occurs during the spring runoff period. The major form of inorganic nitrogen in the soil is usually nitrate, even if ammonium fertilizers are added becuase of the universal occurrence in soil of microorganisms which convert ammonium to nitrate. The nitrate ion is completely dissolved in the soil solution and moves wherever the soil water moves. The nitrate may be leached into the groundwater, into tile drains or into surface runoff. To avoid these losses, moderate amounts of fertilizer nitrogen should be added just before the crop begins its period of minimum growth. If the fertilizer is added too soon, some or most of it may be carried off before the plant can take up the nitrogen. Phosphorus fertilizer reacts rapidly with the soil to form relatively insoluble products. The major source of phosphorus loss from agricultural land is associated with sediment loss. Therefore, control of erosion is essential if phosphorus is to be kept on agricultural land. All of the control measures outlined above are economically feasible. (Schmitt-Iowa State)

0649 - A3, B1, E2

LAND DISPOSAL OF MANURE IN RELATION TO WATER QUALITY,
Cornell Univ., Ithaca, N.Y. Dept. of Soil Science.
S. D. Klausner, P. J. Zwerman, and T. W. Scott.
In: Agricultural Wastes: Principles and Guidelines for Practical Solutions, Cornell University Conference on Agricultural Waste Management, February 10-12, 1971, Syracuse, New York. p 36-46, 8 tab, 10 ref.

Descriptors: *Farm wastes, *Surface runoff, *Fertilization, Soil erosion, Water pollution, Eutrophication, *Waste disposal, Waste water treatment, *Nutrients.

Disposal on land is the most practical final placement for farm manure, as it is a source of plant hutruent and organic matter. Nitrogen in manure is very mobile in a soluble form. Phosphorus becomes 'fixed' and is removed largely by the physical removal of soil, organic matter, or manure by surface erosion. Vegetation acting as a sink for incoming nutrients as well as a control of erosion are necessary for control of nutrient removal. Incorporating the manure with the soil shortly after spreading is an important consideration as immobilization of nutrients increases and odor and fly problems decrease. Winter spreading causes numerous problems. Frozen soil is impervious to water and subject to runoff during thaws. Spring applications of manure can pose a threat to water quality if improperly managed. Late in the spring, surface and subsurface flows of water are no longer at maximum levels, thus decreasing the pollution potential. Concrete evidence as to the maximum rates of manure that can be applied without causing a polltuion hazard under most soil and weather conditions is non-existent. Continuing research hopefully can answer unsolved problems of economic means of handling animal wastes. (Schmitt-Iowa State)

0650 - B1

GUIDELINES FOR MINIMIZING PESTICIDE POLLUTION,

Cornell Univ., Ithaca, N.Y. Chemical-Pesticide Program.
R. F. Pendleton, and J. E. Dewey.
In: Agricultural Wastes: Principles and Guidelines for Practical Solutions, Cornell University Conference on Agricultural Waste Management, February 10-12, 1971, Syracuse, New York. p 47-51.

Descriptors: *Farm waste, *Pesticides, *Pesticide drift, Pesticide toxicity, Water quality control, Phytotoxicity.

The worst aspects of pesticides are usually the most newsworthy. In order to retain the necessary use of pesticides it is imperative to use all possible means to minimize or prevent their becoming pollutants. Pesticides when properly used are tools. When they move off target or are otherwise misused they become pollutants. They become particularly important as pollutants when they move into water and cause either immediate toxicity to organisms present, or, more seriously, are of a persistent and accumulative nature and move into the food chain. Many factors contribute to pesticide drift; some physical, some climatic. The smaller the droplet and the greater the wind, the greater the drift. The choice of pesticides influence drift damage from toxicity, phytotoxicity, illegal residues, and volatilization. Choosing the right machinery for a particular job is most important. In most cases a short-lived, biologically degradable, non-cumulative compound may be substituted for an environmentally dangerous compound. Poor operational procedures and misuses are probably the greatest contribution to pesticide pollution, which can be greatly reduced through education programs involving pesticide applicator safety and known principles of conservation. (Schmitt-Iowa State)

0651 - B1

ANIMAL WASTE HANDLING IN THE UNITED KINGDOM,

Cornell Univ., Ithaca, N.Y. Dept. of Poultry Science.
C. E. Ostrander.
In: Agricultural Wastes: Principles and Guidelines for Practical Solutions, Cornell University Conference on Agricultural Waste Management, February 10-12, 1971, Syracuse, New York. p 52-53.

Descriptors: *Farm wastes, *Dehydration, *Waste water treatment, Aerobic treatment, Anaerobic digestion, Domestic wastes.

The poultry industry in England, Scotland, and Holland is quite different from that in the United States. There are many smaller operations in the 1,000 to 5,000 bird range, they have less mechanization, and they look at quality differently. However, one of the world's largest poultry operations is located near Nottingham, England and produces 60,000,000 broilers a year in addition to maintaining 3,500,000 laying hens. There is much interest in the United Kingdom in dehydration of manure. This is probably due to the fact that they can include dehydrated poultry manure in commercial feed formulations. The United Kingdom is very concerned about water pollution as they depend on rivers for water supply and do not want polluted effluent dumped into them. Holland appeared to be putting fairly potent effluent into drainage ditches. They have tried natural lagoons, but low temperatures and lack of sunshine prevented proper operation. Some are converting to aerated lagoons. Other methods being tried include the Floc-tower system, centrifuging, anaerobic digesting, and aeration in oxidation ditches. They are concentrating livestock, and waste problems are becoming more acute. (Schmitt-Iowa State)

0652 - D4

LIQUID WASTE TREATMENT I. FUNDAMENTALS,

Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
R. C. Loehr.
In: Agricultural Wastes: Principles and Guidelines for Practical Solution, Cornell University Conference on Agricultural Waste Management, February 10-12, 1971, Syracuse, New York. p 54-62, 1 fig, 1 tab.

Descriptors: *Farm wastes, *Aerobic treatment, *Anaerobic digestion, Pollution abatement, *Waste water treatment.

Controlled and uncontrolled biological systems are the major systems used to treat organic wastes. The systems can treat liquid or solid wastes, can be aerobic, anaerobic, or facultative, and can be within controlled structures or unconfined on the land. In biological systems microorganisms utilize the biodegradable wastes for food. Synthesis or growth is affected by the ability of the microorganisms to metabolize the wastes, the temperature and pH of the system, and the presence of adequate nutrients, trace elements, and toxic materials. It is not possible to have a system in which there is no net accumulation of solids with time due to nonbiodegradable material. Bacteria are the most important group of microorganisms followed by fungi, which are non-photosynthetic multicellular plants. Algae are photosynthetic autotrophs, utilizing sunlight and inorganic compounds to synthesize cells. In aerobic treatment carbon is oxidized to microbial protoplasm and carbon dioxide, while in anaerobic systems some carbon is reduced only to methane. For optimum nitrification a dissolved oxygen concentration of about 2 mg/l is necessary. In general, microbial reaction rates are doubled for every 10 deg C rise in temperature of the waste system. (Schmitt-Iowa State)

0653 - D4

LIQUID WASTE TREATMENT II. OXIDATION PONDS AND AERATED LAGOONS,

Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
R. C. Loehr.
In: Agricultural Wastes: Principles and Guidelines for Practical Solutions, (Cornell University Conference on Agricultural Waste Management, February 10-12, 1971, Syracuse, New York. p 63-71, 3 fig, 1 tab, 2 ref.

Descriptors: *Farm wastes, *Oxidation lagoons, *Farm lagoons, *Aeration, *Aerobic treatment, Dissolved oxygen, *Waste water treatment.

Oxidation ponds and aerated lagoons are among the simplest liquid waste treatment systems currently used. Bacteria and algae are the key organisms in an oxidation pond, with the active bacterial mass under 50 mg/l. In most oxidation ponds there are ample algal nutrients in the influent carriage water and resulting from bacterial metabolism to produce excess oxygen from algal growth. Satisfactory performance depends on the balance between the bacteria and the algae. Oxidation ponds are organic matter generators, since algal cells are produced. Unless algal cells are removed from the effluent of the pond prior to discharge, little reduction in the ultimate waste load will have occurred. Temperature affects the rate of metabolism of microorganisms; thus, the rate at which the pond can be loaded. Loading relationships should be in terms of BOD5 per surface area per day, and generally range from 20 to 50 pounds per acre per day. An aerated lagoon differs from an oxidation pond in that aerobic conditions are maintained by mechanical means, with algae generally not present. Dissolved oxygen should be maintained at 1-2 mg/l with the detention time from 1-10 days. (Schmitt-Iowa State)

0654 - D4

LIQUID WASTE TREATMENT III. THE OXIDATION DITCH,

Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
R. C. Loehr.
In: Agricultural Wastes: Principles and Guidelines for Practical Solutions, Cornell University Conference on Agricultural Waste Management, February 10-12, 1971, Syracuse, New York. p 72, 2 fig, 1 tab, 1 ref.

Descriptors: *Farm wastes, *Sewage treatment, *Aerobic treatment, Oxygen demand, Stabilization, Oxidation lagoons, *Waste water treatment.

The oxidation ditch, or Pasveer ditch, is an aerobic biological waste treatment system with a long liquid detention time and adequate mixing. The key components are a continuous open channel and a surface aeration rotor, which mixes the ditch contents and supplies oxygen. Untreated wastes can be added directly to the ditch. The effluent from agricultural wastes normally is not suitable for discharge to surface waters, but is suitable for land disposal. If sufficient oxygen is supplied, odors are negligible. BOD5 reductions of 80-90% can be obtained. Characteristics include low capital cost, ease of operation, and minimum maintenance. The total solids concentration can range up to 4-6%. Because of long detention times, the food to organism ratio is only from .03 to 0.1 lb. BOD per lb. MLVSS (Mixed Liquor Volatile Suspended Solids) per day. Velocities of 1.0 to 1.5 ft./sec. should be maintained to minimize settling. The depth of liquid ranges from 15 to 30 inches with rotor immersion one-fourth to one-third the liquid depth. Livestock oxidation ditch effluent must be kept in aerated holding units or disposed of in a short time to avoid anaerobic conditions and odors. (Schmitt-Iowa State)

0655 - D4

ANAEROBIC BIOLOGICAL WASTE TREATMENT SYSTEMS,

Cornell Univ., Ithaca, N.Y. Dept. of Environmental Engineering.
A. W. Lawrence.
In: Agricultural Wastes: Principles and Guidelines for Practical Solutions, Cornell University Conference on Agriculture Waste Management, February 10-12, 1971, Syracuse, New York. p 79-92, 6 fig, 3 tab, 18 ref.

Descriptors: *Farm wastes, *Anaerobic digestion, *Methane bacteria, *Waste water treatment, *Farm lagoons, Pollution abatement.

The anaerobic process, one of the major biological wastewater treatment processes, is most effectively applied in the treatment of concentrated wastes, such as those from animal production exceeding 1% organic solids. The anaerobic process converts organic matter to methane and carbon dioxide. The methane can be vented to the atmosphere or burned as a heat source. Microbiologically, the anaerobic process is complex with many species of microorganisms involved. However, the bacteria can be functionally divided into two groups, acid formers and methane formers. The methane producing bacteria are extremely sensitive to environmental change. A typical organic loading rate for a completely mixed tank is .2 lb. volatile solids per day per cubic foot. Completely mixed systems are quite expensive and require extensive operator control, which makes them unattractive for agricultural purposes. The lagoon is probably the most widely used anaerobic process configuration in agricultural waste treatment at this time. Attractions include low capital and operating costs and minimal operating requirements. Anaerobic processes can be designed by either the rational approach which applies to completely mixed systems or the empirical method which is used in designing lagoons. (Schmitt- Iowa State)

0656 - A9, D3

CHLORINATION OF WASTEWATER EFFLUENTS,
Cornell Univ., Ithaca, N.Y. Dept. of Environmental Engineering.

In: Agricultural Wastes: Principles and Guidelines for Practical Solutions, Cornell University Conference on Agricultural Waste Management, February 10-12, 1971, Syracuse, New York. p 93-101.

Descriptors: *Farm wastes, *Disinfection, *Chlorination, Water treatment, Public health, Waste water treatment, Diseases.

Certain diseases caused by enteric pathogenic microorganisms can be transmitted from infected human and animal sources to susceptible human populations by water supply systems. Examples include typhoid and cholera. Due to water supply and recreational use of our rivers, there is a trend to require disinfection, or chlorination, of sewage and wastewater. Aqueous solutions of chlorine can be prepared from either dissolution of gaseous chlorine or the hypochlorite salts. Chlorine, as a strong chemical oxidizing agent, inactivates the key enzyme systems within the pathogenic microorganism. The process of chlorination is usually controlled by measurement of the chlorine residuals and is called the orthotolidine test. Pathogenic organisms are usually present in very low numbers; therefore, indicator organism used in wastewater is called the coliform group, consisting of bacteria of intestinal origin of warm-blooded animals, the same origin as the pathogens. Coliforms, however, have a longer survival time in natural waters. Factors affecting disinfection include temperature, contact time, concentration, chlorine species present, pH, and type of organism. Cost of chlorination is on the order of one cent per thousand gallons of wastewater, with control of the process being straightforward and relatively simple. (Schmitt-Iowa State)

0657 - D2, D3, D4

SOLIDS DESTRUCTION OR SEVERE TREATMENT,
Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
D. C. Ludington.
In: Agricultural Wastes: Principles and Guidelines for Practical Solutions, Cornell University Conference on Agricultural Waste Management, February 10-12, 1971, Syracuse, New York. p 102-106, 1 fig, 1 tab, 3 ref.

Descriptors: *Farm wastes, *Waste water treatment, *Incineration, *Solid wastes, Pollution abatement, Chemical degradation.
Identifiers: Wet-air oxidation process.

There are three basic processes which can be used to destroy solid matter or convert solid matter into liquids or gases. These three processes are (1) biological, (2) chemical, and (3) thermal. A biological process is one which utilizes bacteria to decompose or break down solid matter. These processes can only attack those solids which can be biologically degraded. Biological processes can be subdivided into two categories; aerobic which require the presence of dissolved oxygen, and anaerobic which takes place in the absnece of dissolved oxygen and produces offensive odors as products of destruction. Total reduction for biological destruction is 30-50%. Chemical destruction of solids is a process which chemically oxidizes the solid material in an aqueous solution at high pressure and temperature and in the presence of air but without a flame. The process, also known as the wet air oxidation process, operates at temperatures about 500 deg F and pressures from 150 to 3000 psig and can effectively convert all the volatile solids in solid material into carbon dioxide, water, and nitrogen. Thermal destruction is the rapid oxidation at temperatures 1000 to 1400 deg F, near atmospheric pressure and with a flame. Also known as incineration, this process can convert all the volatile solids to gaseous products and heat. (Schmitt-Iowa State)

0658 - D2

MOISTURE REMOVAL,
Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
A. T. Sobel.
In: Agricultural Wastes: Principles and Guidelines for Practical Solutions, Cornell University Conference on Agricultural Waste Management, February 10-12, 1971, Syracuse, New York. p 107-114, 7 fig, 1 tab, 4 ref.

Descriptors: *Farm wastes, *Dehydration, *Drying, *Absorption, Waste storage, Incineration, Waste water treatment.

Removal of water from animal manures provides many advantages for manure management systems, including a reduction in offensive odor, a reduction in weight and volume, and a change in handling characteristics. The range of ideal moisture content is 10-15%, since ammonia is produced in the 75-15% range, and below 10%, the manure becomes dusty. The possible means of water removal are, (1) mechanical, (2) absorption, and (3) thermal. Mechanical removal consists of using pressure to force the water from manure. Absorption is a functional method of moisture removal as long a sufficient absorption material and air movement is provided. Thermal means of moisture removal can be subdivided into dehydration and drying. Dehydration, the removal of moisture at a temperature considerably greater than ambient, must be accomplished in complex equipment with the added cost of a fuel source. Drying, the removal of water by evaporation at a temperature slightly above ambient, is controlled by, (1) environment, (2) configuration, and (3) air movement. Thickness of manure should be 1/4 inch or less for drying with a maximum air flow of 800 fpm. Dehydration should be considered only if there is a market available for the dehydrated product, or if the cost is considered a treatment. (Schmitt-Iowa State)

0659 - C5, D4

COMPOSTING,
Rutgers - The State Univ., New Brunswick N.J. Dept. of Soils and Research.
S. J. Toth, and B. Gold.
In: Agricultural Wastes: Principles and Guidelines for Practical Solutions, Cornell University Conference on Agricultural Waste Management, February 10-12, 1971, Syracuse, New York. p 115-120, 2 tab, 11 ref.

Descriptors: *Farm wastes, *Artificial use, *Aerobic conditions, *Humus, Thermophilic bacteria, Carbon cycle, Decomposing organic matter.
Identifiers: *Composting.

The production and use of artificial manures or coposts for soil improvement practices is as old as the art of agriculture. Composting can be defined as the process involving the conversion of organic residues into liqnoprotein complexes (humus) via thermophilic organisms under optimum moisture and aeration conditions. In the process, CO2 is evolved and the temperature of the pile may reach 155 to 170 deg F. Air moisture, nitrogen, phosphorus, and potassium are necessary ingredients for composting. Unless sufficient moisture is present the pile will dry out and decomposition will cease. If too much moisture is present or air is excluded, anaerobic conditions are produced and obnoxious odors will result. Microorganisms require nitrogen for their growth so composts made from plant materials with less than 2% total nitrogen will require the addition of either organic or inorganic nitrogen. Small amounts of additional phosphorus and potassium may be needed, with 20 pounds of superphosphate and 10 pounds of muriate of potash usually being sufficient. Any materials containing cellulose can be composted, the only exceptions being plastics and resins with a closed ring structure. Characteristics of ideal compost include dark color, inorganic matter content of 80% or more, moisture content between 10 and 20% total nitrogen from 2.5 to 3.5%, and a pH between 5.5 and 6.5. Due mainly to low organic matter, garbage composting in the United States has been largely unsuccessful. (Schmitt-Iowa State)

0660 - E2, E3

UTILIZATION OF AGRICULTURAL WASTES,
Agricultural Research Service, University Park, Pa.
W. R. Heald, and R. C. Loehr.
In: Agricultural Wastes: Principles and Guidelines for Practical Solutions, Cornell University on Agricultural Waste Management, February 10-12, 1971, Syracuse, New York. p 121-129, 49 ref.

Descriptors: *Farm wastes, *Waste disposal, *Water reuse, Fertilization, Artificial use, Waste disposal.
Identifiers: Recycling.

Waste management can be thought of in three categories: the prevention of, the recovery of, or the disposal of wastes. Recovery, or recycling is the return of wastes to its natural state, and along with salvage, or utilization of wastes is potentially the most efficient operation. The land will continue to be the ultimate disposal site for animal wastes, and is considered a recycling process when coupled with crop production. Benefits other than nutrient value include increased infiltration capacity of the soil, and reduced soil erosion resulting from better plant cover. Methods of utilizing animal wastes are composting, energy or methane production and refeeding. Composting is feasible but a market must be developed before the process is financially attractive. In general, the nutritive value derived from animal wastes incorporated in feed rations is greater if the wastes of single stomached animals are added to the feed ration of ruminants and if the ruminant wastes are treated chemically before being added to feed rations. Unknowns related to transmittal of drugs, feed additives, and pesticides to the second animal and to the agricultural product, such as eggs and milk, remain to be classified. A variety of costs must be developed before the value of utilization and recycling can be determined.
(Schmitt-Iowa State)

0661 - A5, B1, C3, D3, E1

ODORS AND THEIR CONTROL,
Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
D. C. Ludington.
In: Agricultural Wastes: Principles and Guidelines for Practical Solutions, Cornell University Conference on Agricultural Waste Management, February 10-12, 1971, Syracuse, New York. p 130-136, 1 fig, 1 tab, 12 ref.

Descriptors: *Farm wastes, *Odor, *Poultry, Runoff, Water pollution, Air pollution, Air circulation, Waste treatment.
Identifiers: *Odor control, Soil columns, Cages, Plow-furrow-cover, Oxidation ditch, Chemical treatment, Odor control costs.

The seriousness of odors produced from poultry operations have increased with changes to the 'modern' poultry house. Sources of odors around a poultry operation includes: (a) ventilation air, (b) loading areas and outside storage tanks, and (c) the land after spreading. Controlling odors from these sources can be accomplished to varying degrees by different methods. The following list of odor control methods is an attempt to put these methods in perspective as to success of odor removal. Ranking of odor control methods for the various odor sources: (a) Ventilation air: (1) adequately aerated liquefied manure, (2) moisture removal (moisture content reduced to 30-40% w.b.), (3) frequent (daily) cleaning, (4) chemical treatment (if sufficient chemical is used, this treatment could be higher on the list); (b) Loading area and outside storage tanks: (1) adequately aerated liquefied manure, (2) moisture removal (30-40%), (3) chemical treatment; (c) Land after spreading: (1) adequately aerated liquefied manure, (2) plow-furrow-cover or sub-surface injection, (3) moisture removal, (4) frequent cleaning and spreading (daily), (5) chemical treatment. The final decision on an odor control method must be based upon cost and the local situation. The local situation depends upon nearness of neighbors or degree of odor control necessary. No matter how carefully the method is chosen, if good management and good housekeeping are not followed, the system will fail. (Bundy- Iowa State)

0662 - B1, F4

WASTE HANDLING ALTERNATIVES,
Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
R. W. Guest.
In: Agricultural Wastes: Principles and Guidelines for Practical Solutions, Cornell University Conference on Agricultural Waste Management, February 10-12, 1971, Syracuse, New York. p 137-141, 2 fig.

Descriptors: *Farm wastes, Liquid wastes, Odor, Waste storage, Storage capacity, Aerobic treatment, Oxidation lagoons, Cattle, Poultry, Swine, *Waste water treatment, Waste disposal.
Identifiers: *Semi-fluid material, Manure spreaders.

Methods of handling agricultural manures are changing. The reason--primarily because the predominant form of the manure has changed. Prior to ten years ago, more or less, straw or other bedding was used which absorbed part of the moisture in the manure. Not only has the form changed, but also a drastic increase in the volume of waste material to be handled in one location has occurred. The conventional method of handling manure is with the conventional manure spreader (without modification), gutter cleaners, pit scrapers and manure bucket loaders. To be successful using the conventional method, dairy manure and poultry manure must have dry matter added, whereas swine manure can be spread without added dry matter. Semi-fluid material is of most interest because most of today's large operations use this method. The solution to handling semi-fluid rests with three alternatives: (1) develop equipment to handle it in this form, (2) change to liquid by adding water, or (3) change the form to a solid. The liquid handling is gaining popularity because conventional mechanical pumping methods may be used. The ease of storing liquids is also an advantage for using this system. It enables an operator to store manure, thus reducing labor. The treatment process must be considered, however, in any of these systems to reduce odors. (Bundy-Iowa State)

0663 - B1, F2

INTEGRATION OF COMPONENTS INTO A SYSTEM,
Cornell Univ., Ithaca, N.Y. Dept. of Poultry Science.
R. J. Young.
In: Agricultural Wastes: Principles and Guidelines for Practical Solutions, Cornell University Conference on Agricultural Waste Management February 10-12, 1971, Syracuse, New York, p 142-149. 7 fig.

Descriptors: *Farm wastes, *Water quality act, Landfills, Farm lagoons, Incineration, Treatment, Oxidation lagoons, Regulations, Fertilizers, Nutrients, *Standards, *Institutional constraints.
Identifiers: *Air quality standards, Land spreading, Composting, Local regulations, State regulations.

In analyzing the various methods for handling animal wastes, each method must be considered with the individual management application in mind. It is also apparent that there are a number of constraints and alternatives which must be taken into consideration before a given system is adopted. These constraints are the local, state and federal regulations in regard to air and water quality standards, public health laws and environmental protection regulations. The long-range consequences of any action taken must be evaluated so that the solution of one waste disposal problem does not create another. High priority should be given to the incorporation of animal wastes into a cropping system to get the maximum uptake of nutrients. If possible, recycling and reuse of animal wastes should be part of the management system. The primary consideration is to be given to source control. Examination of all of the feasible methods that meet the conditions of state and federal regulations may show that the cost of waste disposal for a particular product is far too costly, and therefore a more economical procedure may be a change in management practice which would prevent or significantly reduce the amount of waste materials generated.
(Bundy-Iowa State)

0664 - F3

ADVISORY GROUPS FOR ENVIRONMENTAL PROTECTION AND AGRICULTURAL COOPERATION,
Wisconsin Univ., Madison. Dept of Dairy Science.
J. W. Crowley.
In: Agricultural Wastes: Principles and Guidelines for Practical Solutions, Cornell University Conference on Agricultural Waste Management, February 10-12, 1971, Syracuse, New York, p 150-156.

Descriptors: *Farm waste, Regulations, Waste disposal, Cattle, Public health, Safety, Legal aspects.

The idea of an advisory group can be illustrated by experiences with advisory groups in other general problems. In dairy production, the involvement of various production groups, marketing groups, and quality control agencies has a long history. There have been occasions when one group formulated ideas without due consideration of the needs or responsibilities of the other group. Also, there have been many questions or problems that require immediate practical solutions but only judgment or guesses are available. When this occurs, the best judgment or guess results when all groups involved discuss, debate, and finally compromise on the practical solution. The primary objective of the advisory committee is to develop guidelines. These must be acceptable to all groups that have enforcement responsibilities. The suggestions in the guidelines must also be practical and realistic; however, they cannot assure compliance with regulations. The advisory committee is essentially an Ad Hoc group; however, permanent structure is needed so that a representative can request and get action for revision. The guidelines are essentially an educational publication and should be continually up-dated as needs arise. (Bundy-Iowa State)

0665 - B2

WASTE MANAGEMENT ON A MODERN DIARY FARM,
R. Everingham.
In: Agricultural Wastes: Principles and Guidelines for Practical Solutions, Cornell University Conference on Agricultural Waste Management, February 10-12, 1971, Syracuse, New York, p 157-160.

Descriptors: *Farm waste, *Cattle, Confinement pens, Soil disposal fields, Septic tanks, Odors, Liquid wastes, New York, Waste treatment.
Identifiers: *Dairy wastes, Liquid-manure spreader, Pit agitation, *Syracuse (N.Y.).

A New York dairy farmer gives an account of his 100-cow free-stall liquid-manure-handling system. The system is located within a 15-minute drive to downtown Syracuse, which makes him very aware of the odor problems that a dairy operation might cause. The liquid manure tank was designed on the specifications of 1-1/2 cubic feet per animal per day with enough capacity for two months. At the time the pit was built, it was decided that a two-month clean-out period would be sufficient, but after operating the system for awhile, it was recognized that a four-month period would be better. This would eliminate having to spread the manure during the summer months or the cold winter months on frozen ground. Also, the specifications of 1-1/2 cubic feet per animal per day should be increased to 2. The equipment used to remove the manure consists of an agitator pump and a 1400-gallon liquid-manure spreader. In his operation, the spreading, especially in the summer, is the most critical part of the operation. The operator at this point feels the system is workable.
(Bundy-Iowa State)

0666 - A2, B1, F2

PERFORMANCE OF DUCK WASTEWATER TREATMENT FACILITIES,
New York State Veterinary Coll., Eastport. Duck Disease Research Lab.
K. J. Johanson.
In: Agricultural Wastes: Principles and Guidelines for Practical Solution, Cornell University Conference on Agricultural Waste Management, February 10-12, 1971, Syracuse, New York, p 161-166. 3 fig, 3 ref.

Descriptors: *Farm waste, *Poultry, Oxidation lagoons, Settling basins, Waste water disposal, *Waste treatment, Chlorine, Run-off, *Treatment facilities.
Identifiers: *Pre-settling lagoon, Confined buildings, *Duck wastes.

The Long Island duck industry is presently comprised of 35 farms and processing plants, marketing approximately 7 million ducks a year. This figure represents about 65% of the nation's ducks with the majority going to New York restaurants and markets. A minimum of 6 gal. of water per duck per day is necessary. Most farmers use between 10 and 20 gal. of water per duck per day. In the past, ducks were given free access to the freshwater streams and rivers and their wastes were carried out into the waterway, which caused serious pollution. In order to curb this pollution, the New York State Department of Health required duck farmers to comply with a four-phase program of water pollution abatement. The first two phases of this program called for the removal of ducks from open waters and providing facilities that would remove settleable solids. The third phase of the order called for the disinfection of the waste effluent. The fourth phase called for nutrient removal. Each farm involved in waste treatment is issued an operating permit after the system has been inspected and approved by the New York State Dept. of Environmental Conservation. The permit describes the approved facilities and specifies what equipment is incorporated into the system, such as the size,' number and capacity of aeration lagoons, settling lagoons, chlorination tanks, pumps, and the number of aerators to be utilized. These facilities cannot be altered without prior approval of the New York State Department of Environmental Conservation. (Bundy-Iowa State)

0667 - D1, F5

FOOD PROCESSING WASTEWATER TREATMENT,
Harnish and Lookup, Assoc., Newark, N.Y.
P. Russell.
In: Agricultural Wastes: Principles and Guidelines for Practical Solutions, Cornell University Conference on Agricultural Waste Management, February 10-12, 1971, Syracuse, New York, p 167-172. 3 fig, 2 tab, 14 ref.

Descriptors: *Waste water treatment, Irrigation, Lagoons, Activated sludge, Aeration, Water management, New York.
Identifiers: *Food processing, Wastes, Spray irrigation.

In the food processing sector of the agricultural industry, wastewater treatment and disposal is one of the most significant problems facing today's corporate management. In New York state alone, over 100 food processing plants produce wastewater equivalent to 5 million people. The problem must be completely determined in order to provide a proper wastewater management program. An in-plant wastewater sampling program is essential to determine wastewater sources and characteristics. A process flow schematic is also essential. To treat the wastewater, preliminary treatment includes screening, nutrient additions, pH control, and equalization in many cases. In some cases, spray irrigation is a very suitable means for wastewater disposal from food processing operations. The important elements of a spray irrigation system are adequate surface area and a soil which allows for infiltration into the ground. In other instances where a BOD removal efficiency up to 85% is adequate, aerated lagoons have been employed successfully in treating food processing wastewaters. Methods including stabilization ponds, filter, and chemical treatment are used when advanced treatment is necessary.
(Bundy-Iowa State)

0668 - C1, D4

PHOTOSYNTHETIC RECLAMATION OF AGRICULTURAL SOLID AND LIQUID WASTES--SECOND PROGRESS REPORT,
California Univ., Berkeley. Sanitary Engineering Research Lab.
Gordon L. Dugan, Clarence G. Golueke, William J. Oswald, and Charles E. Rixford.
California University, Sanitary Engineering Research Laboratory, Report No. 70-1, 165 p, 24 fig, 55 tab, 51 ref. US Public Health Service 5RO1 UI 00566-03.

Descriptors: *Farm wastes, *Poultry, Waste water treatment, Sedimentation, Oxidation lagoons, Anaerobic digestion, Algae, Sludge, Methane, Organic loading, Hydrogen ion concentration, Temperature, Centrifugation, Coagulation, Dewatering, *Cost analysis.
Identifiers: Volatile solids, Grit.

A 36-week study was initiated to provide information on the economics of treating animal wastes. Chickens were chosen, mainly for convenience sake, as the waste producers to be studied, and 113-twenty week old leghorn pullets were placed in cages. The treatment system used consisted of inclined troughs under the cages which were flushed with water from a flushing bucket, grit removal, sedimentation, an oxidation lagoon for the sedimentation tank supernatant, and an anaerobic digester for the solids. The systems approach was used, and system balances were performed for total solids, volatile solids, total unoxidized nitrogen and energy for the chickens, sedimentation tank, digester, and algae. All balances were performed from week 5 through week 36 except for the digester, where operation was terminated at week 24 and the solids dewatered, dried, and studied for possible further reuse. An economic analysis of an integrated system of 100,000 laying hens revealed a cost of approximately 2 cents/dozen eggs for a system based on the one tested. However, consideration of an extremely conservative algae harvesting rate of 12 tons/acre/year at a price of 5 cents/lb (dry weight) dropped the overall waste handling outlay to approximately 1 cent/dozen. On this basis, additional studies were recommended to aid in the implementation of treatment facilities for animal wastes as soon as [illegible]. (Lowry-Texas)

0669 - A2, B1

ANIMAL AND HUMAN METABOLIC WASTES.
Illinois Univ., Urbana. Council on Environmental Quality.

Proceedings of First Allerton Conference, December, 1970, Special publication no. 21, College of Agriculture, Illinois University at Urbana-Champaign, April, 1971, p 23-25. 2 tab.

Descriptors: *Farm wastes, *Water pollution, *Biochemical oxygen demand, *Sludge disposal, Municipal wastes, Anaerobic digestion, Oxidation, Fertilizers.
Identifiers: Pollution abatement, Population equivalents.

Livestock needed to produce America's meat supply also produce 2 billion tons of manure per year. Undiluted livestock wastes are 100 times more concentrated than municipal sewage. Pollutants include plant nutrients, oxygen-demanding components, infectious agents, color, and odor. Aerobic bacteria thrive at Dissolved Oxygen levels down to .5 ppm, but fish need about 4 ppm. Typical BOD livestock population equivalents include dairy cow — 12, 200 pound hog — 2.5, and laying hens — 0.10. The greatest potential for stream pollution is feedlot runoff. Methods of abatement include diverting rainwater around lots, collecting runoff in detention ponds, and putting roofs over lots. Most odor nuisance can be avoided by incinerating, composting, refeeding proteinaceousisolids, or anaerobically digesting. Farmland can be used to dispose of digested sludge of municipal waste treatment plants. Typical fertilizer contents of total sludge (water and solids) are 5 per cent nitrogen, 3 per cent phosphorus, and .5 per cent potassium. Land, not watercourses, should be the receptor of livestock and municipal waste residues. (Schmitt-Iowa State)

0670 - B1, D1, E1, F4

ALTERNATIVES FOR THE TREATMENT AND DISPOSAL OF ANIMAL WASTES,
Cornell Univ., Ithaca, N.Y. Dept. of Civil and Agricultural Engineering.
Raymond C. Loehr.
Journal Water Pollution Control Federation, Vol 43, No 4, p 668-678, 2 fig, 2 tab, 10 ref.

Descriptors: *Farm wastes, *Disposal, *Treatment, *Systems analysis, Runoff, Pollutant, Nutrients, Aerobic treatment, Anaerobic digestion, Denitrification, Nitrification, Effluents, Legal aspects, Waste water treatment, Waste disposal.
Identifiers: Options, Land disposal, Oxidation ditch, Pollutional characteristics alternatives.

The various systems for treating wastes from enclosed confined animal production operations are discussed. There is no one process or waste management system that will be adequate for all animal production operations. Aeration systems such as oxidation ditches are gaining acceptance for waste handling and treatment. It is unlikely that current liquid waste treatment systems for treating concentrated animal waste water will produce effluents that can be discharged to surface water. Land disposal is an integral part of feasible animal waste treatment systems. (Christenbury-Iowa State)

0671 - A5, C2, D2

REMOVAL OF WATER FROM ANIMAL MANURES, PART II: EFFECTS OF VELOCITY ON AIR DRYING,
Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
A. T. Sobel.
In: Agricultural Waste Management and Associated Odor Control, Cornell University AWM 71-04, September 1, 1971. 10 p, 2 tab, 7 fig, 4 ref.

Descriptors: *Farm wastes, *Poultry, *Drying, Waste storage, Odor.
Identifiers: Air-drying manure.

Water can be removed from animal manures by mechanical, thermal, and absorptive means. Thermal removal was investigated by utilizing a thin layer of unheated air, and a very low or 'static' air velocity. The equilibrium moisture content of chicken manure is comparable with other agricultural hygroscopic materials. Effects of humidity on drying time are significant but sample variation has an effect similar to a plus or minus 15% relative humidity change. Temperature, configuration of manure, thickness, compaction, velocity of air, and the biological state of the manure also affects the drying rate. Exposure to drying on both sides had an effect on 1/4 in. thick manure samples for velocities less than 700 FPM, but the effect was insignificant for 1/8 in. samples. Velocities greater than 800 FPM did not appreciably reduce the drying time from that of the 800 FPM level. Drying times for velocities 800 FPM or greater were approximately 1/3 that for 'static' conditions. The time required to remove the last 0.9 percent of water was approximately 8 hours at 'static' conditions and 5 hours at the higher velocities.
(Schmitt-Iowa State)

0672 - A6, C3

MEASUREMENT OF MANURE GASES BY GAS CHROMOTOGRAPHY,
Illinois Univ., Urbana. Dept. of Agricultural Engineering.
D. L. Day.
In: Agricultural Waste Management and Associated Odor Control, Cornell University, AWM 71-04, September 1, 1971. 6 p, 1 fig.

Descriptors: *Farm wastes, *Gas chromatography, *Ammonia, *Carbon dioxide, Methane, *Hydrogen sulfide.

Identifiers: Varian Aerograph Model 200 Chromatograph, Porapak T, Porapak S, Porapak Q, Porapak R, Carle T.C. detector.

A combination of gas chromatograph equipment was sought to measure manure gases, specifically ammonia. Previous work had used both thermal conductivity and hydrogen flame detectors for measuring methane, hydrogen sulfide, and carbon dioxide. A setup using silica gel and molecular sieve columns in series was considered undesirable since the molecular sieve is suspected of permanently retaining CO2, NH3, and H2O. Experiments were conducted with a Varian Aerograph Model 200 Chromatograph with T.C. detector with a 1/8 in. X 8 ft. of 100-120 Porapak T column and a Carle T.C. detector with 1/8 in. X 8 ft. of 50-80 mesh Porapak Q in series with 1/8 in. X 8 ft. of 50-80 mesh Porapak R. Ultimately it was found that there was as much CO2 in a cylinder marked as 123 ppm NH3 and the balance N2 as in a CO2 cylinder marked as 0.49% CO2, 20.8 O2, and balance N2. This explained the identical elution time for the NH3 and CO2 cylinders. 123 ppm NH3 was below the detection level for the gas chromatograph setups. NH3 in the absence of CO2 was used in other tests. The thermal conductivity and hydrogen flame detector chromatographs were not very reliable for quantitative measurement of ammonia in the 2,000 to 12,000 ppm concentration range; the threshold level appears to be 1% or higher. (Schmitt-Iowa State)

0673 - A5, C1

OLFACTORY MEASUREMENT OF ANIMAL MANURE ODOR,
Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
A. T. Sobel.
In: Agricultural Waste Management and Associated Odor Control, Cornell University, AWM 71-04, September 1, 1971. 21 p, 12 fig, 7 tab, 11 ref.

Descriptors: *Farm wastes, *Poultry, *Drying, *Odor.
Identifiers: Air-drying manure.

The gas chromatograph can detect compounds to 10-12g of any material, but odorous compounds below this level can be readily detected by the human nose. Consequently, an odor panel was created and asked to rate various manure samples as to the presence of odor, and the offensiveness of the odor. A scale of 0-10 was used with zero representing no odor and 10 representing a very strong and offensive odor. Samples included manure that was undiluted, diluted in various proportions, and manure that was dried to various moisture contents. The use of a rating method utilizing the human nose for odor evaluation provides valuable information for comparing manure handling and treatment systems. Ratings for odor presence and odor offensiveness are very similar. Descriptive terms help in catagorizing odors. Olfactory observation along with visual observation produces a different rating in comparison with olfactory observation only. Visual observation may introduce some bias. Since there is no right answer to an olfactory test, the test must be set up and run under conditions such that the results can be used for comparison only. (Schmitt-Iowa State)

0674 - A5, B1, C1

CONTROL OF ODORS THROUGH MANURE MANAGEMENT,
Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
D. C. Ludington, A. T. Sobel, and B. Gormel.
In: Agricultural Waste Management and Associated Odor Control, Cornell University, AWM 71-04, September 1, 1971. 17 p, 13 fig, 8 tab, 2 ref.

Descriptors: *Farm wastes, *Poultry, *Drying, *Odor.
Identifiers: Air-drying manure.

Attempts to mask, counteract, or oxidize odors from manure have been largely unsuccessful. If odors cannot be controlled once they have been formed, an effort must be made to inhibit the production of odors. To evaluate the success of efforts to control odors a measuring device is needed. A panel of humans rating odor presence and offensiveness from 1 to 10 has been found the best device for evaluation. Experiments were conducted to check the influence of moisture removal and manure removal on the odor offensiveness of the gases released from chicken manure. Removing moisture reduced the odor level. Diluted manure always produced the highest offensiveness and undiluted manure the next highest. Daily scraping which did not allow buildup of manure was also a successful technique for controlling odor. A manure management system which either removes the manure from the building at least daily without manure buildup or removes moisture from the manure will cause a minimum amount of air pollution. (Schmitt-Iowa State)

0675 - D2

UNDER CAGE DRYING OF POULTRY MANURE,
Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
B. Gormel, A. T. Sobel, and D. C. Ludington.
In: Agricultural Waste Management and Associated Odor Control, Cornell University, AWM 71-04, September 1, 1971. 15 p, 7 fig, 7 tab.

Descriptors: *Farm wastes, *Poultry, *Drying, Waste disposal, Odor.
Identifiers: Air-drying manure.

Various means to achieve drying of poultry droppings before they could mat together into a solid mass were investigated. Fins made of different materials placed at various angles, screens, and rotating pins were investigated, with air movement at 3 to 4 cfm per bird. The moisture content of manure from caged layers was reduced to 50% by use of metal fins below the cages. Fins at more than 45 deg. angles caught a low percentage of the manure and thus, had small effect. Supplementary fins at 30 deg. beneath the 45 deg. fins were not self-emptying. Air circulation is of great importance in fin drying of poultry manure. Vertical fins will hold about 46% of the total manure when the fins are placed 3/4 in. apart. Half-inch expanded metal allowed too high a percentage of fresh droppings to pass into the pit to be a significant benefit in the drying process. Rotating pins reduced the moisture content to about 50% but something stronger than the 1/4 in. maple dowel 7 3/4 in. pins is needed. In these tests, drying took place partially on the devices such as screens, metal fins or spindles with significant additional drying of the crumbled manure occurring in the chamber pits because the devices prevented the formation of a solid mass of droppings in the pit. (Schmitt-Iowa State)

0676 - A4, C3, C4, C5

CHEMICAL AND MICROBIAL STUDIES OF WASTES FROM BEEF CATTLE FEEDLOTS,
Agricultural Research Service, Lincoln, Nebr. Soil and Water Conservation Research Div.
T. M. McCalla, and F. G. Viets, Jr.
Proceedings: Pollution Research Symposium, May 23, 1969. Typescript, 24 p, 14 tab, 77 ref.

Descriptors: *Microorganisms, Chemical properties, Cattle, Farm wastes, Odor, Runoff, Confinement pens.
Identifiers: Great Plains, Nebraska, Feedlot.

Chemical and microbial characteristics of beef cattle waste are discussed along with some of the possible microbial and chemical transformations that reduce the disposal problem. The cattle feedlot waste depends on the ration feed. Generally, cattle in feedlots are started on a high-roughage ration and quickly shifted to a high-concentrate one. A high-concentrate ration has about 75% to 85% digestible material and 5% to 7% minerals, resulting in 4 to 5 lbs. of feces per animal per day. Pollution of groundwater beneath beef cattle feedlots appears to be determined by a number of factors, namely, stocking rate, manure removal, depth of water table, and soil texture and structure. Indications are that low stocking rates and frequent manure removal contribute to nitrate leaching into the water table. Also, feedlots in which the groundwater is relatively close to the surface are more apt to contain nitrate in excess of 10 ppm than are feedlots with a deeper water table. Beef cattle feedlots established on coarse-textured, sandy soils may permit more movement of pollutants to the groundwater than those established on fine-textured clay soils. (Dorland-Iowa State)

0677 — A1, B1, D1, E1, F1

THE POLLUTION POTENTIAL OF THE CONFINED LIVESTOCK FEEDING INDUSTRY
Midwest Research Institute, Kansas City, Missouri,
The Pollution Potential of the Confined Livestock Feeding Industry, Final Report, Midwest Research Instiuite, 425 Volker Bolevard, Kansas City, Missouri, November, 1971. pp. 1-224.

Descriptors: *Farm Wastes, Biochemical Oxygen Demand, Cattle, Feedlots, Waste Treatment, Economic, Runoff, Aerobic Treatment, Sheep, Swine, Poultry.
Identifiers; Manure Handling Techniques.

The confined livestock feeding industry has been studied in depth. Typical feedlot operations have been examined, livestock wastes have been characterized, and waste management techniques and treatment processes have been evaluated. Animal wastes are highly concentrated. Conventional treatment processes can be applied to these wastes, but will not produce effluents suitable for stream discharge. Such treatment, therefore, is seldom feasible and rarely necessary if good management practices are followed. Animal waste management is aimed at returning the wastes to the land, with essentially no effluent reaching natural waterways. Appropriate management practices include: 1) minimizing the quantity of runoff by diversion of all water outside the feedlot; 2) Controlling runoff emanating from inside the feedlot; 3) detaining liquid runoff fro mthe feedlot in ponds or lagoons; 4) returning the detained liquids to the lands as required to prevent detention pond overflow; and 5) periodically removing solid wastes from feedlots for ultimate disposal on land. Such practices will be compatible with the industry's economic structure, acceptable to the industry's management, and effective in eliminating known pollution hazards. Auditional research is needed to insure that the synthetic chemicals used in livestock feeding operations are not harmful when returned to the environment. (Bundy-ISU)

0678 - F4

THE FUTURE OF FARM ANIMAL WASTE MANAGEMENT,
Minnesota Univ., Minneapolis. Dept. of Agricultural Engineering.
James A. Moore, and Donald B. Brooker.
Agricultural Engineering, Vol 51, No 7, p 414, 417, July 1970.

Descriptors: *Farm waste, *Water treatment, *Water pollution control, *Long term planning, Manure, Odor, Agricultural engineering.

Predicts the future development of livestock waste management schemes. It includes a discussion of future water quality requirements as well as the necessity for odor control. The need for mechanization as well as increased energy consumption are discussed. (Miner-Iowa State)

0679 - A3, C3

NITROGEN LOSSES FROM ALKALINE WATER IMPOUNDMENTS,

San Diego State Coll., Calif. Dept. of Civil Engineering.
Frank E. Stratton.
Journal of the Sanitary Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 95, No SA2, p 223-231, 1969. 5 fig, 1 tab, 3 ref.

Descriptors: *Alkaline water, *Nitrification, *Nitrogen, Impoundments, Ammonia, Analysis, Analytical techniques, Hydrogen ion concentration, Temperature, Winds, Effluents, Lakes, Surface waters, California.
Identifiers: Elfin Forest Lake (Calif), Gaseous ammonia nitrogen, Degasification.

A method of estimating the loss of gaseous ammonia from alkaline waters consists of analysis of samples from outdoor impounded water subject to mixing by wind. Another method involves the use of a floating cell and acid trap to determine ammonia liberated from an impoundment. The field tests were conducted from June to September in two small California eutrophic impoundments: Elfin Forest Lake with pH 9.5-9.8, and a pH 9.1 effluent pond at the Santee Water Reclamation. The measured rate of loss of ammonia nitrogen for the Elfin Forest Lake was 3.3 milligrams per square foot/day, whereas that for the Santee pond, 9.1 milligrams per square foot/day. The determined values constituted 14% and 22% of the predicted values for these basins, respectively. (Wilde-Wisconsin)

0680 - B1, F3, F4

ECONOMIES OF RECOVERY AND DISTRIBUTION OF ANIMAL WASTE,

California Univ., Davis.
W. J. Clawson.
Journal of Animal Science, Vol. 32, No. 4, April 1971, p 816-820, 1 tab, 9 ref.

Descriptors: *Farm wastes, Economics, Cropland, California, Waste management, *Waste disposal, *Waste treatment, *Feed lots.

No one method will satisfy the need for suitable waste management in animal agriculture. Two basic pathways seem to be available for disposal of animal waste. The first is utilization of all or parts of the animal waste where a cost is incurred and a value for the product (s) is returned. The alternative may be outright destruction or degradation of animal waste where a cost is incurred and no return is evident. Acknowledgment must be made of the fact that agriculture will be forced to stop pollution and that the additional cost of this type of waste management may not be recovered from waste alone. Future research must help provide more methods of cleaning and transporting animal wastes. Another approach is to study methods which will permit the effective growth and fattening of animals in less confined areas than is currently the case. By treating the removal and distribution of animal wastes as an expense to the animal production industry, evaluation of waste disposal methods is improved and a more intelligent evaluation of alternative methods may be made by the animal industry. (Bundy-Iowa State)

0681 - C2, D4, E2

EFFECT OF FEEDLOT LAGOON WATER ON SOME PHYSICAL AND CHEMICAL PROPERTIES OF SOILS,

Kansas State Univ., Manhattan. Dept. of Agronomy, and Kansas State Univ., Manhattan. Dept. of Agricultural Engineering.
David O. Travis, W. L. Powers, L. S. Murphy, and R. I. Lipper.
Partially supported by OWRR, Dept. of Interior.
Soil Science Society of America Proceedings. Vol 35, No 1, p 122-126, January-February 1971. 5 p, 7 fig, 4 tab, 12 ref. OWRR Project A-016-KAN (2).

Descriptors: *Farm wastes, *Water pollution effects, *Path of pollutants, *Irrigation water, *Waste water disposal, Lagoons, Saline soils, Nitrates, Salts, Leaching, Soil water, Soil chemistry, Soil properties, Soil texture, Soil structure.
Identifiers: Feedlot lagoons.

Lagoon water from cattle feedlot runoff was added to undisturbed soil columns 42 cm long and 6.7 cm in diameter. The infiltration rate of the lagoon water into the columns was measured and recorded. After each run, the soil columns were sectioned into 3-cm increments and analyzed for Ca, Mg, Na, K, and NH4 ions. Also the electrical conductivity of a saturation extract from the top 15 cm of each column was determined. Water flow in the soil columns stopped for all soils before two pore volumes of filtrate could be collected. The percentages of Na, K, and NH4 ions increased in the surface increments of the soil columns. The electrical conductivity of the saturation extracts for all soils was increased by more than 200% by adding the lagoon water to the soil. The saturation extract of the treated soils had electrical conductivity values of between 2.80 and 5.05 mmhos/cm. (Knapp-USGS)

0682 - A5, D2, F2

AERATION OF LIQUID POULTRY MANURE; A STABILIZATION PROCESS OR AN ODOUR CONTROL MEASURE,

Guelph Univ. (Ontario). Dept. of Microbiology.
R. G. Bell.
Poultry Science, Vol. 50, No. 1, January 1971. p 155-158. 3 fig, 9 ref.

Descriptors: *Farm wastes, Biochemical oxygen demand, *Odor, *Aeration, *Poultry, Anaerobic digestion, *Degradation (Decomposition), Liquid wastes, *Waste water treatment.
Identifiers: Fatty-acids.

The offensive odors associated with the storage of liquid manures are caused by the accumulation of the by-products of the anaerobic decomposition of fecal organic matter. A direct relationship has been observed between the concentration of one such group of by-products, the volatile fatty acids, and the odor quality of stored liquid poultry manure. It was suggested that a 0.1% fatty acid content was an acceptable level for new facilities and 0.2% was a minimum level for the initiation of prosecutions under any proposed air pollution legislation. Aeration, on purely theoretical grounds, must be a means of preventing stored liquid manure from acquiring a foul odor since anaerobiosis and the presence of free oxygen are incompatible. In practice it is now well established that aeration is an effective way by which to control the odor of liquid manure. The present study was undertaken to ascertain whether the fatty acid content remained a reliable odor assessment criteria for aerated stored manure; and to observe whether an aeration rate sufficient to control odor would result in the stabilization of the manure. The fatty acid content was shown to provide a reliable assessment of the odor quality of stored aerated liquid poultry manure. For satisfactory odor control in the manure storage system containing 0.562 cu. ft. of water per hen it was only necessary to satisfy 37% of the daily applied BOD. Aeration as used in the experimental system must be considered as an odor control measure and not as a stabilization process. (Bundy-Iowa State)

0683 - B1, F4

ANIMAL WASTE HANDLING AND DISPOSAL IN CONFINEMENT PRODUCTION OF SWINE,

Purdue University, Lafayette, Ind. Dept. of Animal Science.
J. H. Conrad, and V. B. Mayrose.
Journal of Animal Science, Vol. 32, No. 4, April 1971. p 811-815. 22 ref.

Descriptors: *Farm wastes, *Confinement pens, *Swine, *Odors, Farm management, Irrigation, Biochemical oxygen demand, *Aeration, *Waste water treatment.
Identifiers: Slotted floors.

Farmer-producers are becoming larger and more specialized. An estimated twenty-five percent of the hogs are produced in total confinement and another fifty percent of the hogs produced by large producers are in partial confinement during the growing and/or finishing period. As confinement feeding increases, concern about the volume of wastes excreted does also. Some procedures of measuring and facts about fecal production are discussed. An ideal manure handling system should incorporate the ultimate in automation, oxidize volatile solids, require a minimum amount of maintenance and be economical to operate. Waste disposal systems discussed include; mechanical or hand scraping and cleaning in conjunction with total hauling and spreading, a combination of scraping and flushing the wastes into a lagoon or holding pit, a slotted floor over a pit, a slotted floor over a pit with oxidation wheel, slotted floor over a lagoon, slotted floors over a pit with oxidation wheels and a lagoon, and the plow-furrow-cover technique. Another problem with swine confinement is gas generation. Some of the gases generated are toxic while others cause offensive odors. Speculation into the future has come up with this system, perhaps with slight modifications, as an acceptable one. Animals will be reared in totally enclosed buildings on slotted floors. Wastes will be flushed by recycled lagoon water into the lagoon which contains a floating aerator. Effluent containing both liquid and suspended fine solids will be used for crop irrigation. (Bundy-Iowa State)

0684 - A2, A5, D1, E1

CHANGING PRACTICES IN AGRICULTURE AND THEIR EFFECT ON THE ENVIRONMENT,

Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering; and California Univ., Davis. Dept. of Agricultural Engineering.
Raymond C. Loehr, and Samuel A. Hart.
CRC Critical Reviews in Environmental Control, Vol 1, No 1, p 69-99, February 1970. 31 p, 7 fig, 9 tab, 67 ref.

Descriptors: *Reviews, *Bibliographies, *Water pollution sources, *Farm wastes, Waste treatment, Aesthetics, Odors, Sewage disposal, Disposal, Farm management, Water pollution control, Environment, Water quality, Air pollution, Urbanization.
Identifiers: Animal production wastes.

This review emphasizes one facet of agriculture, animal production as an example of the changes that have taken place in agriculture. The major topic areas include: productivity increases, changes in size of operations, handling problems, waste characteristics, surface and groundwater quality, land application of wastes, land runoff, odor production, and waste management techniques. Because farms are located in relative isolation surrounded by apparently unlimited land, air, and water, contaminants generated by agriculture usually would be sufficiently dilute or stabilized before potential problems become real. Modern developments in agriculture and growing recreational use of rural lands are tending to eliminate this relative isolation. The large livestock producer is in the animal rather than in the crop-farming business. He relies on commercially available feeds for a considerable portion if not all of his feeding requirements, has a minimum interest in utilization of the resultant manure in crop production, and may not have adequate land of his own for satisfactory disposal of the animal wastes. The outlook is for continuation of these trends in modern agriculture and for an increase in the environmental problems described in this review. No new facility or expansion of existing facilities for agricultural production should be considered without prior planning which should include the probable environmental effects of the disposal of wastes from the facility. (Knapp-USGS)

0685 - A5, A6, B1, D1

GASES AND ODORS FROM STORED SWINE WASTES,
Illinois Univ., Urbana. Dept. of Agricultural Engineering.
Arthur J. Muehling.
Journal of Animal Science, Vol 30, No 4, p 526-531, April 1970. 18 ref.

Descriptors: *Farm wastes, Ammonia, Manure, *Gases, Odor, Methane, Carbon dioxide, Hydrogen sulfide, *Hogs.
Identifiers: Swine confinement, *Manure odors, Storage pits.

One major problem arising from the storage, handling, treating and eventual utilization or disposal of hog wastes associated with confinement hog systems is the inevitable presence of gases and odors. The most important gases generated in a hog confinement unit are thought to be carbon dioxide, ammonia, hydrogen sulfide, methane and a large group of trace compounds such as amines, mercaptans, and skatoles. Under normal conditions in an adequately ventilated confinement unit no noxious gas reaches lethal or even harmful concentrations for pits or humans. Critically dangerous conditions exist when the oxygen content of the air diminishes from the normal 21 to 10% or less. It is only under special conditions such as during a ventilation failure, or during rigorous agitation of the manure pit that dangerous levels are reached. It may be possible to apply the industrial methods of treating odors; namely, dilution, absorption, adsorption, masking, counteraction and burning to the control or odors from stored manure. (Miner-Iowa State)

0686 - E3, F5

NEW PROCESS CONVERTS CATTLE RUMEN TO FEEDSTUFF,
D. Natz.
Feedstuffs, Vol 43, No 28, July 10, 1971. 1 fig.

Descriptors: *Farm wastes, Cattle, Suspended solids, *Waste treatment, *Feeds.
Identifiers: Feeding trials.

A practical means of turning rumen content (paunch) of slaughtered cattle into a valuable feed ingredient is claimed by Dr. Paul A. Stahler, a Minnesota medical doctor. The patented 'Stahler Conversion Process' actually converts the paunch material into two usable feed ingredients. One is a concentrated liquid fed to hogs as a top dressing over grain. The other is a dehydrated product which is fed to cattle much like silage. Stahler's process first separates the liquids and solids by suction, then compresses the high moisture solids to extract more liquid. The liquids then go into a holding for sterilization and processing. The solids move into a revolving drum-type heating and drying unit where they are exposed to 2000 to 3000F temperatures. The solids can then be pelleted if desired. Stahler reported that the paunch, when processed according to the prescribed methods, will provide a minimum of 75% of the commonly accepted nutritive requirements of beef cattle during the finishing phase. He said that it has even more potential as a pre-finishing ration - from about 400 to 800 pounds. The cost to produce this material in 1960 was about $17.04 per ton. During feeding trials conducted by Stahler, cattle gained an average of 2.5 pounds per day on a ration of which a major part was paunch products. Stahler predicted that beef production nationally could be increased by 25% by utilizing the rumen content of animals as a feed product. (Wallin-Iowa State)

0687 - B2, D4, F5

OPERATION OF AN ANAEROBIC POND ON HOG ABATTOIR WASTEWATER,
Steeg (Henry B.) and Associates, Inc., Indianapolis, Ind.; and Wastewater Treatment Plant, Logansport, Ind.
C. F. Niles, and H. P. Gordon.
In: Proceedings, Industrial Waste Conference, 25th, May 5-7, 1970, Purdue University, Engineering Extension Series No. 137, Part II, p 612-616, 1 tab.

Descriptors: *Waste water treatment, *Operating costs, Anaerobic conditions, Effluents, Activated sludge, Biochemical oxygen demand, Labor, Pretreatment, Management, Indiana, *Lagoons, *Industrial wastes.
Identifiers: *Abattoir wastewater, Anaerobic lagoons, Secondary treatment, Suspended solids.

The development of a design for an anaerobic pond for pretreatment of the wastewater from an abattoir, design criteria and details of the anaerobic pond, and the operating techniques being used in treating the effluent from the anaerobic pond before discharge to the river are described. Some information on operating results, labor requirements and power consumption are also included. It was estimated that processing 400 hogs per hour on a one shift kill would result in a flow of 800,000 gal per day with a peak rate of 1400 gal per min. It was further estimated that this wastewater would contain 8000 pounds of BOD and 6650 pounds of suspended solids per day. The effluent from the lagoon was introduced into the activated sludge secondary treatment step of the city sewage treatment plant. For successful operation on a year-round basis, a cover for the lagoon was considered necessary. The cover was composed of straw and grease and maintained temperatures year-round above 80 degrees F. (Dorland-Iowa State)

0688 - C2, C3, C4, C5

CHARACTERIZATION OF WASTE TREATMENT PROPERTIES OF PIG MANURE,
Newcastle-upon-Tyne Univ. (England). Dept. of Agricultural Engineering.
J. R. O'Callaghan, V. A. Dodd, P. A. J. O'Donoghue, and K. A. Pollock.
Journal Agriculture Engineering Research, Vol 16, No 4, p 399-419, December 1971. 13 fig, 15 tab, 8 ref.

Descriptors: *Farm wastes, *Hogs, Feeds, Biochemical oxygen demand, Chemical oxygen demand, Solid wastes, Hydrogen ion concentration, Nutrients, Phosphorus, Potassium, Confinement pens.
Identifiers: *Total solids, Volatile solids.

The daily faecal and urinary production from individual pigs were measured over the live-weight range 20-90 kg. Three different feeding regimes were employed. Faecal and urinary production can be expressed as a percentage of meal and water consumed; the values are influenced by feeding regime. The results from the study on individual pigs were, in general, confirmed by a trial carried out on groups of pigs. There was no significant difference in the quantity of manure produced by hogs and gilts. Feeding regime was found to influence significantly the major properties of pig manure. The properties studied included biochemical oxygen demand, chemical oxygen demand, total solids, volatile solids, pH and the major nutrient elements, nitrogen, phosphorus and potassium. No significant reduction in either oxygen demand or volatile solids was achieved by storing the manure in dung channels for periods of up to 18 weeks. (Bundy-Iowa State)

0689 - A3, B1, F4

WASTE MANAGEMENT FOR FEEDLOTS,
Nebraska Univ., Lincoln. Coll. of Agriculture.
E. A. Olson.
Extension Service Bulletin, E.C. 71-795, (1971). 14 p, 15 fig.

Descriptors: *Farm wastes, *Nebraska, Livestock, Runoff, *Feed lots, *Water pollution control, *Pollution abatement, Legal aspects.

Guidance and information are provided to help livestock producers develop facilities that will, by proper waste management, help prevent pollution. Careful selection of a new site for livestock production facilities can help reduce potential water and/or air pollution problems. Methods for controlling and managing waste runoff for existing or new lots are described. These techniques are based on results of recent research on waste management by USDA Agricultural Research Service personnel and the University of Nebraska. The Nebraska Water Pollution Control Act requires that programs to control livestock wastes be operational by December 13, 1972. (Bundy-Iowa State)

0690 - B1, C1

AN IMPROVED METHOD FOR SEPARATE COLLECTION OF URINE, FECES, AND EXPIRATORY GASES FROM THE MATURE CHICKEN,
Agricultural Research Service, Fargo, N. Dak. Metabolism and Radiation Research Lab.
G. D. Paulson.
Poultry Science, Vol 48, No 4, p 1331-1336, 1969. 3 fig, 7 ref.

Descriptors: *Farm wastes, *Urine, *Poultry, Sampling, Carbon dioxide.
Identifiers: Surgical modification, Poultry urine collection, Metabolism cage.

An improved method for surgical modification of the chicken and collection apparatus to facilitate separate collection of urine and feces is described. There was no mortality from surgery, and the modified birds were normal, as evaluated by outward appearance, feed and water consumption, urine and feces excretion, and post examination of sacrificed birds. A metabolism unit and a system for collecting respiratory CO2 from the chicken are also described. (Miner-Iowa State)

0691 - B3, C2

THE EFFECT OF HUMIDITY AND FLOORING TYPE ON THE MOISTURE CONTENT OF BROILER EXCREMENTS,
West Virginia Univ., Morgantown. Dept. of Animal Industries and Veterinary Science.
R. A. Peterson, M. A. Hellickson, W. D. Wagner, and A. D. Longhouse.
Poultry Science, Vol 49, No 2, p 439-443, March 1970. 1 fig, 2 tab, 2 ref.

Descriptors: *Farm wastes, Livestock, *Poultry, *Manure, Humidity, Air environment.
Identifiers: Broilers, Moisture content, *Flooring systems.

Experiments were conducted in part to determine the effect of humidity and flooring type on the moisture content of excreta from broilers. The experiments using broiler type chicks fed a high energy ration were conducted in four controlled 1.2 x 2.4 x 2.4 m environmental chambers. Relative humidity was measured and maintained. The following types were used, (1) 2.5 cm by 2.5 cm. welded wire (2) 1.3 cm. by 2.5 cm. welded wire and (3) 1.9 cm. flat wooden slats spaced 0.6 cm. apart. The average moisture content was significantly less in excreta collected under 1.9 cm. flat slats than collected beneath either 2.5 x 2.5 cm. or 1.3 x 2.5 welded wire floors. (Miner-Iowa State University)

0692 - B1, C1

EFFECT OF FEED PROCESSING ON DIGESTIBILITY OF ANIMAL FEEDS,
Kansas State Univ., Manhattan.
H. B. Pfost.
(1970) 21 p, 22 tab, 20 ref.

Descriptors: *Farm wastes, Feeds, Feed lots, Cattle, Microorganisms, Ammonia, Hogs.
Identifiers: *Daily gain, Daily feed, Starch.

Some degree of starch gelatinization improves the feed efficiency for beef, swine and broiler feeding enough to be economically feasible under typical conditions in the United States. The utilization of urea in ruminant rations can be improved by use in combination with gelatinized starch. The results of using a highly gelatinized product for feeding swine appear interesting from a research standpoint and may prove to be practical later. Much of the past research which involved grain processing is difficult to interpret because of the failure to measure and report chemical and physical changes which occurred during processing. Standardized methods which are correlated with animal performance need to be developed. Protein availability must be considered as well as starch availability. Future developments in equipment for processing must consider the economic costs required to obtain desired levels or product change. (Bundy-Iowa State)

0693 - C5

IDENTIFICATION AND EXCRETION OF ESTROGEN IN URINE DURING THE ESTROUS CYCLE OF THE EWE,
Purdue Univ., Lafayette, Ind. Dept. of Animal Sciences.
E. D. Plotka, and R. E. Erb.
Journal of Animal Science, Vol 29, No 6, p 934-939, 1969. 2 fig, 1 tab, 27 ref.

Descriptors: Farm wastes, *Sheep, *Urine, Organic compounds, *Chromatography.
Identifiers: Estrone, *Estrogen, Pregnant ewes.

Estrone was identified in urine of the non-pregnant ewe by comparing its behavior to crystalline standard estrone and by its failure to separate from added 14C-estrone through solvent partitioning, paper chromatography, successive thin-layer chromatography in different systems, gas-chromotography, (GLC) on three columns, derivative formation and chromatography of the derivatives. The highest average rate of excretion of estrone and estradiol occurred during estrus averaging 394 and 479 ug./24 hr. as compared to the lowest rates of 20 and 17 ug./hr., respectively, the second day after estrus. Expressing excretion rate as ng/mg. of urinary creatine was highly correlated (r-0.97-0.98) to total excretion based on total collection of urine for 24 hours. (Miner-Iowa State)

0694 - A2, B1

MANAGEMENT PRINCIPLES APPLICATION TO THE DISPOSAL OF CATTLE MANURE TO PREVENT POLLUTION,
Washington State Univ., Pullman. Coll. of Engineering Research Div.
D. E. Proctor.
Paper presented at the Eighth Texas Industrial Water and Wastewater Conference, Lubbock, Texas, June 6, 1968. 13 p, 1 fig.

Descriptors: *Farm wastes, Dairy industry, *Waste disposal, Confinement pens, Runoff, *Washington, Aerobic treatment, Lagoons.
Identifiers: Anaerobic lagoons, *Monroe (Wash).

The Sanitary Engineering Section of the College of Engineering Research Division was asked to consider the manure problem at a dairy and milk processing plant near Monroe, Washington. Winter flooding and cost were two problems that influenced the systems set up for the 230 to 240 cows. The final system consisted of scraping and flushing the manure into a central slurry sump. From here the manure can either be pumped to the fields for disposal through a manure 'gun' or pumped to one of three storage lagoons. Each lagoon measures 115 feet by 115 feet by 18 feet and all three can hold about 430,000 cubic feet of material. (Wallin-Iowa State)

0695 - A5, B1

CONTROL OF POULTRY HOUSE VENTILATION SYSTEMS USING SOLID-STATE CONTROLS,
Agricultural Research Service, State College, Miss. Farm Electrification Research Branch.
F. N. Reece, and J. W. Deaton.
Transactions of the American Society of Agricultural Engineers, Vol. 14, No. 6, p 1073-1075, November-December, 1971, 3 fig, 2 tab, 7 ref.

Descriptors: *Confinement pens, *Ventilation, *Poultry, Temperature, Cooling, *Waste treatment.
Identifiers: *Solid-state controls, Humidity controller, Variable-speed d-c motor.

Chickens, because of size, growth characteristics and sensitivity to light, lend readily to manipulation of production efficiency through confinement housing. However, as with any livestock, the success of confinement housing is dependent largely on the ventilation system. The conventional poultry-house ventilation system generally uses multiple fans, usually low-pressure axial-flow type, controlled by time clocks and thermostats, to regulate ventilation rate and control house temperature and humidity. The application of solid-state voltage control devices, used to control the speed of permanent split-capacitor, fractional-horsepower motors, further refines the system by providing resolution of the incremental steps of the multiple-fan system. The application of variable-speed, 1-hp and larger, d-c, electric motors with solid-state control to poultry-house ventilation systems appears to offer a method of solving some of the current problems in ventilation systems. By using a variable-speed, d-c motor and an appropriate, solid-state power controller regulated manually in summer and by means of dry-bulb or dew-point temperature transducers in winter, ventilation rate can be controlled in windowless poultry houses over the entire range necessary for optimum conditions throughout the year. The system provides a method of reducing the complexity of design and operation of ventilation systems. (Bundy-Iowa State)

0696 - A2, C1, C5

QUALITY OF EFFLUENT FROM SWINE PRODUCTION AREAS,
North Carolina State Univ., Raleigh. Dept. of Biological and Agricultural Engineering, and North Carolina Water Resources Research Inst., Raleigh.
J. W. D. Robbins, G. J. Kriz, and D. H. Howells.
Paper No. 69-706 presented at 1969 Winter meeting of the American Society of Agricultural Engineers Chicago, Illinois, December 9-12, 1969. 42 p. 21 fig, 4 tab, 21 ref. FWPCA Grant 13020 DGX.

Descriptors: *Farm wastes, Water quality control, *Surface waters, Discharge, Lagoons, Hogs, *Nitrates phosphorus, Coliforms, Biochemical oxygen demand, Chemical oxygen demand, *Toxicity, Antibiotics, Water pollution sources.
Identifiers: *Effluent disposal, Land application, Direct discharge, Automatic sampler, Feed additives.

Results are presented of the swine waste phase of a study initiated to identify the amounts of and factors governing pollutional loadings reaching surface waters and to answer whether and under what conditions animal wastes are a significant source of stream pollution. Knowledge of these factors is necessary to develop meaningful waste control, treatment, and disposal requirements for surface water protection. Results from representative swine waste management systems of lagooning, land disposal, and direct discharge to stream demonstrated the superiority of land disposal in controlling stream pollution. Discharge of lagoon effluents or direct discharge into surface water is unacceptable from a water quality standpoint. In land disposal, care must be taken that good management practices of soil and water conservation are followed to minimize movement of wastes into streams. The amount of wastes applied per unit area should be low enough to prevent excess nitrate levels in groundwater. Toxic substances in the wastes are a cause of difficulties in BOD testing lagoon wastes. (Dorland-Iowa State)

0697 - A2, A3, B1, C1, E1

ROLE OF ANIMAL WASTES IN AGRICULTURAL LAND RUNOFF,
North Carolina State Univ., Raleigh. Dept. of Biological and Agricultural Engineering.
Environmental Protection Agency, Water Pollution Control Research Series, August 1971. 114 p, 32 fig, 19 tab, 75 ref, 2 append. EPA Program 13020 DGX 08/71.

Descriptors: *Farm wastes, *Runoff, *Agricultural runoff, *Water pollution, *Farm lagoons, Waste disposal, Sampling, Analysis, Disposal.

Twelve typical agricultural areas representing three types of animal waste management techniques--lagooning, direct discharge into streams, and land spreading including pasture and drylot units--were studied to determine the amounts of and factors governing stream pollution from swine, dairy, beef, and poultry production operations. More than 1500 stream and lagoon effluent samples were collected with an automatic sampler developed for the study. The samples were analyzed for bacteria, nutrients, and degradable organics. Hydrological and waste management data were also collected. Study results point to the superiority of land spreading for the disposal of animal wastes. Good soil and water conservation practices should be used to minimize the movement of wastes into streams. Higher rates of runoff result in heavier pollution. The location of disposal areas away from streams is important in controlling the amount of entering wastes. Even when land disposal areas are poorly located, the amount of pollution entering streams is usually low, and watershed factors, such as surface culture and ease of erosion, are of primary importance in governing the magnitude of pollution which reaches the streams. Direct dumping of animal wastes, treated or untreated, into streams is completely unacceptable and should be prohibited. (Dorland-Iowa State)

0698 - A2, A9, C1, D1

CHARACTERISTICS AND EFFECTS OF CATTLE FEEDLOT RUNOFF,
Robert S. Kerr Water Research Center, Ada, Okla.
M. R. Scalf, W. R. Duffer, and R. D. Kreis.
In: Proceedings, Industrial Waste Conference, 25th, May 5, 6, and 7, 1970. Purdue University, Engineering Extension Series No. 137, Part 2, p 855-864, 10 fig, 3 tab, 6 ref.

Descriptors: *Farm wastes, *Runoff, *Fishkill, Cattle, Dissolved oxygen, Diversion structures, Sedimentation, Biochemical oxygen demand, Algae, Confinement pens, Impoundments, *Water pollution sources, *Agricultural runoff, *Water pollution effects, *Cattle, *Feed lots.
Identifiers: Algal blooms.

Cattle feedlot capacity in the United States has been increasing at about 10 percent annually in recent years. Essentially, all this growth has been in the form of large scale feedlots of 5000 to 100,000 head capacity. As with the concentrations of people, the concentration of thousands of animals in a small area produces massive environmental problems. Rainfall runoff may contain pollutant concentrations 10 to 100 times those of raw municipal sewage, and uncontrolled access to streams can result in oxygen depletion, fish kills, and other long term, undesirable ecological conditions for miles downstream. This study was designed to measure the quantity of rainfall runoff and its pollutional characteristics from a commercial feedlot and evaluate the effect of this wastewater on small impoundments. Less than two weeks of sedimentation in runoff collection ponds produced on effluent with pollutant concentrations of 10 to 30 per cent of the mean direct runoff concentrations. The necessity of further treatment was demonstrated when the feedlot operator pumped collection pond effluent through an inadequate treatment system into a 45-acre flood control reservoir. Essentially, all game fish in the reservoir were killed due to dissolved oxygen stress and high ammonia concentrations. (Dorland-Iowa State)

0700 - A2, B1, F2

LIVESTOCK WASTE DISPOSAL AND WATER POLLUTION CONTROL,
Colorado State Univ., Fort Collins. Cooperative Extension Service.
R. W. Hansen.
Colorado State University, Cooperative Extension Service, Bulletin 480a, October 1971. 13 p, 4 fig, 2 tab, 6 ref, append.

Descriptors: *Farm wastes, Feed lots, Cattle, Runoff, Odor, Lagoons, Settling basins, Nitrogen, Phosphorus, Potassium, Colorado, Waste disposal, Waste water treatment, *Water pollution control.
Identifiers: Controlled runoff, Anaerobic lagoons.

The purpose is to acquaint the feedlot operator and the livestock man with the general requirements for the control of pollution from livestock facilities. Both federal and state agencies are active in developing and implementing controls to enhance environmental quality. These efforts obviously and logically include livestock enterprises. General information is provided on types of systems that may be used to prevent pollution from feedlot runoff. The design of the system should be done by competent engineers. Engineering services are available from the Soil Conservation Service and consulting engineering firms. (Bundy-Iowa State)

0701 - A2, A3, A4, C1

WATER POLLUTION AND AGRICULTURE,
Kansas State Department of Health, Topeka. Environmental Health Services.
M. W. Gray.
(1968), 14 p, 2 tab.

Descriptors: *Farm wastes, Feed lots, Runoff, Kansas, Rainfall, Biochemical oxygen demand, Bacteria, Coliform, Streptococcus, Fishkill, Cattle, Lagoons, Irrigation.

Natural runoff pollution is defined as pollution resulting from all silts and organic materials carried by watercourses not originating from municipal, industrial, or agricultural operations. Agricultural pollution is pollution as a result of surface runoff, seepage, percolation and return flow from cultivated land used for producing food and feed crops. Animal feedlot pollution is pollutants originating from animal feeding operations of restricted area where the feed supply is nutritionally balanced for maximum animal weight gain prior to marketing. The public generally thinks first of pollution as originating from some industrial plant with black clouds of smoke pouring from its stacks and equally black foul liquids pouring from subterranean channels. The public probably will not be acquainted with pollution from agriculture except fishermen who have practiced their art in the areas of some of our highly intensified farming-livestock areas. (Bundy-Iowa State)

0702 - A3, C4

BUFFALO LAKE PROJECT, RANDALL COUNTY, TEXAS.
Robert S. Kerr Water Research Center, Ada, Okla.

December 1968, 64 p, 7 fig, 10 tab, 36 ref.

Descriptors: *Farm wastes, *Runoff, Rainfall, Bacteria, Coliforms, Streptococcus, Lakes, Recreation, Water sports, *Texas.
Identifiers: *Buffalo Lake (Tex).

Buffalo Lake is a shallow, man-made reservoir of 18, 150 acre-feet capacity located on Tierra Blanca Creek, some 50 miles southwest of Amarillo, Texas. During this study the lake was only 13 feet deep at its deepest portion near the dam. At this depth the lake contained 3990 acre-feet of water and had a surface area of approximately 950 acres. The shoreline is characterized by gently sloping sandy beaches readily accessible by automobile. The overall objective of the Buffalo Lake pollution study as sponsored by the Texas Water Quality Board is to determine the cause of the recurring pollution of Buffalo Lake. The objectives include the answers to the following questions: (1) What effect do the various waste sources have on the bacteriological quality. (2) What is the fate of the three indicator groups of bacteria entering the lake. (3) What effect does the extensive water contact recreational use of Buffalo Lake have on the total coliform, fecal coliform and fecal streptococci densities. (4) What are the densities of coliforms in and around the lake before and after rainfall. (5) Does the bottom mud in the lake contain any appreciable densities of the three bacterial indicators. (6) Do any appreciable concentrations of pesticides exist in the lake. (7) What corrective measures should be taken to control the bacterial pollution of Buffalo Lake and its tributaries. It was recommended that the city of Hereford should properly chlorinate its treated sewage effluent on a continuous basis to protect the bacteriological quality of Tierra Blanca Creek; and that any portion of Buffalo Lake which becomes contaminated by bacterial density of over 200 fecal coliforms per 100 ml should be posted to water contact recreation. (Bundy-Iowa State)

0703 - B1, D1

FEEDLOT WASTE MANAGEMENT: SOME SOLUTIONS TO THE PROBLEM,
Agricultural Research Service, Lincoln, Neb.
N. P. Swanson, and C. B. Gilbertson.
Paper presented at the 1971 annual meeting, American Society of Agricultural Engineers, Washington State University, June 27-30, 1971, Paper No. 71-522. 6 p, 9 ref.

Descriptors: *Farm wastes, *Feed lots, Moisture content, Sampling, Runoff, Settling, Basins, Weirs, Analytical techniques.
Identifiers: Bedloads.

Feedlot waste management has come under increased scrutiny for the related reasons of waste disposal problems and pollution potential. Measurement of these wastes is necessary to determine their chemical and physical content, to determine rates of waste accretion and degradation, and to assess the transport of wastes by runoff. Characterization of feedlot wastes required quantitative measurement of manure accumulations on the feedlot surface, runoff from rainfall and snowmelt, movement into the soil profile, and the air quality surrounding the feedlot. The measurement and sampling of runoff from feedlots must include solid contents and bedloads. Some satisfactory methods of measurement include volumetric measurement, Parshall flume, and weirs; methods found unsuitable include the trapezoidal flume and Hs - and H - type measuring flumes. Time-sequential, rotating dipper, proportional samplers are satisfactory for obtaining representative samples of feedlot runoff. Ideally, a runoff hydrograph should be accompanied by a sequence of representative samples of the runoff and bedload, each sample taken over a uniform time interval. (Bundy-Iowa State)

0704 - B1, F1, F2

PLANNING ANIMAL WASTE DISPOSAL SYSTEMS,
Oregon State Univ., Corvallis. Cooperative Extension Service.
W. E. Matson.
Oregon State University, Extension Circular 736, May 1971. 15 p, 15 fig, 4 tab.

Descriptors: Farm wastes, Regulation, Economics, Government agencies, Costs, Waste disposal, Legal aspects, Odor.

Problems of animal waste disposal will continue to be important factors in determining the location of large scale livestock enterprises. The producers and the public must realize animal waste handling, treatment, and disposal will cost something. No one treatment process or treatment system will be the solution for all animal production units. Sanitary engineers, agricultural engineers, economists, agronomists, animal husbandry people, and others will need to closely coordinate activities. Research and demonstration projects are badly needed. Many of the most obvious cases of pollution could have been prevented if the facilities were located in different areas. The economics of pollution and nuisance control in animal production may mean the difference between success and failure for the facility. Livestock operators are urged to keep informed of current regulatory policies of the Department of Environmental Quality. The Cooperative Extension Service can be helpful in planning expansion or dealing with waste disposal problems. (Bundy-Iowa State)

0705 - B1

A MATHEMATICAL SIMULATION OF BEEF ANIMALS--A REALITY WITH POTENTIAL,
Oklahoma State Univ., Stillwater.
M. D. Paine, J. A. Witz, A. F. Butchbaker, J. E. McCroskey, and C. M. Bacon.
Paper presented at the 1971 Fall Meeting, Oklahoma Section, American Society of Agricultural Engineers Stillwater, November 5, 1971. 21 p, 7 fig, 3 tab, 9 ref.

Descriptors: *Mathematical models, *Cattle, *Environmental effects, *Computer models, Computer programs, Simulation analysis, Model studies, Numerical analysis, Data processing, Energy transfer, Metabolism, Theoretical analysis, Optimization, Feed lots, Nutrient requirements, Energy.
Identifiers: Thermal activity, Energy balance.

The development of beef feedlots with one time capacities of 30,000 head and more has created a need for better mathematical estimates of the effects of climate and nutrition upon beef production. This greater production places greater demands upon management and encourages the use of systems modeling techniques to develop a better mathematical model of a beef animal than existed. This model would allow data from feeding trials to be applied to another location in a different environment. The basic conceptual model is represneted by a combination of three energy reservoirs with energy flow between the reservoirs. These reservoirs represent digestion, metabolism, and thermal activity. The model can then simulate growth responses to energy intake and environmental factors. The model can thus be used to calibrate optimum values of the parameters used in a simulation and thus show the most economical feed ration or any other such factor. The model should prove, after further calibration, useful in feedlot situations. The present model and optimization routines can now be used to predict results of management decisions. (Dorland-Iowa State)

0706 - B1, F4

HANDLING, STORAGE, AND TREATMENT OF DAIRY AND BEEF CATTLE WASTES IN CONFINED SYSTEMS,
Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.
J. A. Moore, and D. W. Bates.
Paper No. 69-935, presented at the 1969 Winter Meeting of the American Society of Agricultural Engineers at Chicago, Illinois. 9 p, 6 fig, 8 ref.

Descriptors: *Farm wastes, *Storage tanks, *Disposal, Cattle, Treatment facilities, Confinement pens, Labor, Structural design, Slurries, Storage, Waste disposal, Waste treatment, Waste water treatment.
Identifiers: *Mechanization, *Land spreading, Gutter cleaners, Bedding, Slatted floors.

Increasingly complex systems for manure management of livestock operations have been developed. This complexity is mainly due to pressure from environmental concerns and the need to reduce labor requirements in these operations. The development of manure handling systems in dairy operations is reviewed. These systems range from hand labor systems to the more modern gutter cleaner where the system was completely mechanized to reduce labor to a minimum with a corresponding increase in capital investments. These systems are all based on the liberal use of bedding to absorb the liquid from the wastes. The use of bedding involves the cost of obtaining the bedding and keeping it in place. Producers have begun to try to reduce these costs by reducing the use of bedding. Recently there has been an increase in the use of storage tanks under the floor and the use of slatted or partly slatted floors. If there was little or no bedding in the manure it would spread itself in and out of the building storage tank, eliminating the need for a mechanical distribution system. The need to reduce odors and solids will bring about more efficient treatment systems in the future. (Dorland-Iowa State)

0707 - A5, D3

A METHOD FOR THE TREATMENT OF ANIMAL WASTES TO CONTROL AMMONIA AND OTHER ODORS,
Vineland Labs., Inc., N.J. Research Div.
William Seltzer, Stanley G. Moum, and Tevis M. Goldhaft.
Poultry Science, Vol 48, No 6, p 1912-1918, November 1969. 4 tab, 10 ref.

Descriptors: *Odor, *Ammonia, *Farm wastes, Air pollution, Poultry, Hogs, Cattle, Bactericides.
Identifiers: Paraformaldehyde, Methogen, Odor control, *Manure odors.

Discusses the use of flaked paraformaldehyde for direct treatment of animal wastes to prevent or eliminate the noxious gases from animal quarters. Paraformaldehyde is a mixture of polyoxymethylene glycols containing 90-99% polymerized formaldehyde. Paraformaldehyde liberates formaldehyde gas as it decomposes. For many years ammonia gas has been used to neutralize formaldehyde gas. This work is predicated on using the principal in reverse. The action of the flake paraformaldehyde on the animal wastes was concluded to be both chemical and antimicrobial and these combined actions make it of value in the control of noxious odors and gases emanating as a result of bacterial fermentation. (Miner-Iowa State)

0708 - C3

TOTAL ORGANIC CARBON DETERMINATIONS ON SWINE WASTE EFFLUENTS,
North Carolina State Univ., Raleigh.
J. W. D. Robbins, G. J. Kriz, and D. H. Howells.
Paper presented at the 1969 Winter Meeting American Society of Agricultural Engineering, Chicago, Illinois, December 9-12, 1969. Paper No. 69-928. 26 p, 9 fig, 19 ref.

Descriptors: *Farm wastes, *Biochemical oxygen demand, Hogs, Runoff, Lagoons, Confinement pens, Hydrogen ion concentration, Nitrates, Ammonia, Bacteria, Chemical oxygen demand, *Analytical techniques.
Identifiers: *Total Organic Carbon, Fresh manure.

Total organic carbon measurements (using a Beckman 915TOC analyzer) were made on swine waste effluents to establish a rapid and accurate auxiliary method to substitute for and/or complement the BOD test for determining degradable organic contents and/or oxygen demand loadings. The standard BOD test has very limited value for characterizing fresh swine waste and swine waste lagoon effluents although it has considerable applicability for more dilute swine wastes in land drainage. Toxic substances, high solids contents, and/or the requirements for high dilutions in analyses are major factors in this regard. The TOC analysis provides a convenient, rapid, and dependable method for determining the amount and strength of wastes entering streams through land runoff from swine growing operations. While the TOC can be useful in characterizing raw swine waste effluents, its utility for this purpose is presently limited by difficulties common to the standard BOD analysis. If a satisfactory relationship with oxygen demand could be developed, the TOC test would be a better pollution parameter than BOD. Conjunctive use of BOD and TOC parameters can be useful in characterizing swine wastes and wastewaters, particularly when toxic materials and other factors limit the BOD test. The degree of BOD/TOC variability is one indication of wastewater consistency and the possible presence of toxic materials. Also, the BOD/TOC ratio is an indication of the ease of biodegradation and/or the degree of stabilization. (Bundy-Iowa State)

0709 - A2, F3, F4

BEEF CATTLE FEEDLOT WASTE MANAGEMENT PROGRAM,
Robert S. Kerr Water Research Center, Ada, Okla.
J. L. Witherow, and M. R. Scalf.
Mimeo, April 1971, 2 fig, 1 tab, 11 ref. EPA Program 13040--04/71.

Descriptors: *Farm wastes, *Water pollution sources, *Regulation, Cattle, Kansas, Texas, Oklahoma, Feed lots, Livestock, Confinement pens.

The Environmental Protection Agency's beef cattle feedlot waste research has an objective to develop technically and economically feasible systems to abate the pollutional effects of confined beef production. Surveys show that the number of 1,000 head feedlots and the total number of cattle on feed are increasing while the number of small feedlots is decreasing. This change is in conjunction with a shift of feedlots from the midwest corn belt to the high plains area and the Southwest. A breakdown by states is given for the number of cattle on feed and the size of feedlots. Pollutional damages from large feedlots are cited. Implementing waste management systems in Kansas, Texas, and Oklahoma is by recent laws and specific regulation adopted by agencies of these states. The design requirements are described. Lack of understanding by the feedlot operator and the number of enforcement personnel are major obstacles in implementation. Pollution control and labor cost may result in total environmentally controlled cattle feedlots becoming common during this decade. (EPA abstract)

0710 - B1, D1, E1

FARM ANIMAL WASTE DISPOSAL,
Ontario Water Resources Commission, Toronto. Div. of Research.
S. A. Black.
Water Management in Ontario Research. Publication No. 28, December 1967, 36 p, 1 fig, 9 tab, 44 ref.

Descriptors: *Farm wastes, *Confinement pens, Feed lots, Runoff, Nitrogen, Biochemical oxygen demand, Chemical oxygen demand, Fertilizer, Economics.

The theories and implications involved with the processing, treatment and disposal of farm animal wastes are described. Farm animal wastes have been contributing polluting materials to waterways for many years. The changing nature of farming in the very recent years, however, has increased considerably the pollution potential of farm animal wastes. Since this change is still in process, an intensive study into improving the methods and facilities for the disposal of farm animal wastes is well justified, as the methods of disposal available to the farmer may well control the location and magnitude of his enterprise in the future. (Bundy-Iowa State)

0711 - A4

THE NITRATE HAZARD IN WELL WATER, WITH SPECIAL REFERENCE TO HOLT COUNTY, NEBRASKA,
Geological Survey, Lincoln, Nebr.
R. A. Engberg.
Nebraska Water Survey. Paper 21, University of Nebraska, Conservation and Survey Division, Lincoln, October 1967. 18 p, 6 fig, 15 ref.

Descriptors: *Farm wastes, Feed lots, Nitrates, Wells, Well data, Well regulations, Percolating water, Pumping, Cattle, Water pollution sources, Water pollution.
Identifiers: *Infant feeding.

High nitrate concentrations in drinking water are a potential health hazard and should be of concern to the user. They not only render the water unsafe for use in infant feeding but generally indicate that the supply is contaminated. Reports of high-nitrate water from several wells in northern Holt County prompted the Lincoln, Nebraska, office of the U.S. Geological Survey to look into the problem -- to determine its seriousness, define causes, and suggest ways to cope with it. To augment the analytical information already on file, water samples were obtained from 71 wells for determination of the nitrate concentration. Concentrations ranging from 0.1 to 409 ppm (parts per million) were found. In order to predict whether a certain well is likely to yield water containing nitrate derived from a nearby source, the rate the well will be pumped and the direction of groundwater movement need to be known. The greater the rate of pumping, the greater the area from which the pumped water will be derived. A well inside or very close to a feedlot is likely to yield high-nitrate water whether the rate of pumping is small or large, whereas a well more distant from the feedlot may need to be pumped heavily for the high-nitrate water to be drawn into it. (Bundy-Iowa State)

0712 — C2, C3, C4

CATTLE FEEDLOT WASTE CHARACTERISTICS,

Colorado State University, Fort Collins, Colorado Graduate Student.
E. M. Jex.
Cattle Feedlot Waste Characteristics, Master of Science Thesis, Colorado State University, Fort Collins, Colorado, January 1969, pp. 1-70, 17 fig, 13 tab.

Descriptors: *Farm Wastes, *Feed Lots, Cattle, Biochemical Oxygen Demand, Hydrogen Ion Concentration.

This study was undertaken to investigate the aqueous characteristics of cattle feedlot wastes. There were two areas of investigation: 1) Biochemical oxygen demand (BOD) characteristics; 2) Conductivity, oxidation-reduction potential, pH, dissolved solids, volatile solids, coagulation and foaming characteristics. The data and results reported here represent laboratory analysis of feedlot manure samples (combined urine and feces sample from feedlot pens) diluted with distilled water to varying degrees. A modification of the classical first stage BOD equation was developed which allows calculation of total BOD versus curves which closely approximate the experimental data. Equations were derived from the van't Hoff-Arrhenius relationship permit calculation of the BOD rate constant k and the ultimate combined demand L at any temperature. (Bundy - ISU).

0713 - C2, C3, C4, D4

SOME AEROBIC DECOMPOSITION PROPERTIES OF DAIRY-CATTLE MANURE,

Purdue Univ., Lafayette, Ind. Dept. of Agricultural Engineering.
A. C. Dale, and D. L. Day.
Transactions of the American Society of Agricultural Engineers, Vol 10, No. 4, p 546-548, 1967, 11 fig, 6 tab.

Descriptors: *Aerobic treatment, *Farm wastes, Biochemical oxygen demand, Cattle, Nitrogen, Phosphorus, Potassium, *Waste water treatment.
Identifiers: *Oxidation ditch, Volatile solids.

Additional information on aerobic decomposition properties of dairy-cattle manure would be helpful in designing Pasveer ditch dairy-production units. Information is needed on such characteristics as (a) percent of the volatile solids that can be broken down into carbon dioxide and water, (b) percent of solids that will be left in the ditch, and (c) BOD of the effluent. An experiment was conducted with the above factors in mind. The following conclusions were drawn: (a) the greater the concentration of dairy cattle wastes added to an aerobic digestion chamber, the lower the breakdown of the volatile solids; (b) approximately 50 percent of the volatile solids will be decomposed in a retention time of 18-1/2 weeks when the daily added wastes amount to 1/2 percent of the volume. (Manure contained 12.5 percent dry matter.) (c) Approximately 46 percent of the volatile solids will be decomposed in a retention time of 18-1/2 weeks when dairy cattle wastes are added at a rate of 1 percent of the volume of the aeration chamber daily. (d) The effluent, as indicated by the 5-day BOD, of all systems was reduced by more than 90 percent. (e) Salts are concentrated to some extent, but they did not appear to retard bacterial action for the concentrations obtained. (Bundy-Iowa State)

0714 - C4

EVALUATION OF CULTURE MEDIA FOR THE ISOLATION OF SALMONELLAE FROM FECES,

Iowa State Univ., Ames. Dept. of Veterinary Microbiology and Preventative Medicine.
R. M. Sharma, and R. A. Packer.
Journal of Applied Microbiology, Vol 18, No 4, p 589-595, 1969, 6 tab, 25 ref.

Descriptors: *Salmonella, *Farm wastes, *Cultures, Cattle, Hogs, *Isolation.
Identifiers: Brilliant Green MacConkey Broth, Tetrathionate Broth, Selenite Broth.

A study conducted on 300 fecal samples from a cow and a pig, each artificially contaminated with approximately four Salmonella organisms revealed that, of the three enrichment broths used in conjunction with the three selective media, the maximum number of isolations were obtained with Brilliant Green MacConkey broth (BGMB), followed by those obtained with tetrathionate (TTB), and the least with selenite broth. The combination of BGMB with Brilliant Green neutral red-lactose agar (BGNRLA), and TTB with desoxycholate citrate agar (DCA) gave an equal number of isolations. Of the three selective media used in conjunction with the three enrichment broths, the maximum number of recoveries were obtained on BGNRLA, followed by those on DCA, and least number of isolations on bismuth sulfite agar (BSA). The combination of selenite F broth-BSA appeared to be somewhat inhibitory for the growth of Salmonella organisms. Of the two selective media combinations, the DCA-BGNRLA combination yielded the highest number of isolations. The use of all three selective media gave still better results. (Miner-Iowa State)

0715 - F4

OVERALL PROBLEMS AND AN APPROACH TO DISPOSAL OF ANIMAL WASTE,

Cornell Univ., Ithaca, N.Y. Dept. of Poultry Science.
R. J. Young.
In: Proceedings Poultry Waste Management Seminar, Athens, Georgia, June 23, 1970, p 1-5.

Descriptors: *Farm wastes, *Dehydration, Forced drying, Oxidation lagoons, Odor, Runoff, Poultry, Economics, Waste disposal.

As agricultural specialization, intensity, and productivity increased, problems of disposing of liquid, solid, and gaseous by-products greatly intensified. In addition to the conflict of interest over the environmental quality, is the mammoth problem of disposal of large amounts of solid waste which is not only extremely offensive but has the potential to pollute both surface and subsurface waters. Investigations have been conducted on disposal systems, identification and control of odors, prevention of water pollution, removal of nutrients, reutilization of animal wastes either as fertilizers or feedstuffs, and new methods of waste management which can become economically part of the total production system. As to odors, some masking agents were slightly effective, although the best control was to prevent the formation of the odor compound. The oxidation ditch as well as drying methods in treating animal wastes were also evaluated.
(Bundy-IowaState)

0716 - A8, D4

BIODEGRADATION OF POULTRY MANURE FROM CAGE LAYERS,

Agricultural Research Service, Beltsville, Md. Husbandry Research Div.
C. C. Calvert, N. O. Morgan, R. D. Martin, and H. L. Eby.
In: Proceedings Poultry Waste Management Seminar, Athens, Georgia, June 23, 1970, p 6-12, 3 tab, 2 ref.

Descriptors: Farm wastes, Waste disposal, Poultry, Odor, Biodegradation, Larvae, Nitrogen, Drying, Protein, Fertilizer.
Identifiers: *Pupae meal.

An attempt has been made to degrade poultry manure to a relatively dry and odorless product, and at the same time produce some return over the cost of the investment. The work utilizes the common house fly to process and biodegrade manure from caged laying hens. Two stages of the house fly cycle -- the larvae and pupae -- are used. The fresh manure was seeded with house fly eggs, approximately 3 eggs/gm., and the eggs were allowed to hatch and the larvae were allowed to tunnel and aerate the manure. The process results in deodorizing a very obnoxious product, reducing its moisture content and volume, and has produced byproducts in the form of high protein pupae meal and a potentially useful fertilizer and/or soil conditioner. (Bundy-Iowa State)

0717 - C1, F5

PROCESSING PLANT SANITATION AND ITS RELATIONSHIP TO WASTE MANAGEMENT,

Cagle's, Inc., Atlanta, Ga.
J. K. Keim.
In: Proceedings Poultry Waste Management Seminar, Athens, Georgia, June 23, 1970, p 13-15.

Descriptors: *Farm wastes, Poultry, Biochemical oxygen demand, Sewers, Municipal wastes, *Food processing industry, Water pollution sources, Industrial wastes.
Identifiers: Processing plant sanitation.

In processing plant sanitation there can be no halfway measures. There is no substitute for cleanliness in a food preparation establishment. The problem has two main factors: the amount of pollutants in the effluent, and the amount of effluent itself. The blood during poultry processing creates a big problem. The two largest sources of blood are the blooding alley and the contents of the vacuum lung tank. Some plants still have a contimous stream of water running over the floor while others permit it to accumulate and then at cleaning time push it into a gutter and wash it down to the separator. The majority of the blood handled in this way also ends up in the sewer, only a minor amount being sufficiently solid to fail to escape from the separator. If the plant is connected to a city sewer, the chances are very great that the charge is based on B.O.D. load. These charges would soon pay for equipment to reduce the loading. Relatively new cleaning systems utilize high pressure and small volume and make the cleaning operation more efficient. (Bundy-Iowa State)

0718 - F5

WATER UTILIZATION IN PROCESSING PLANTS,

Agricultural Research Service, Athens, Ga. Animal Products Lab.
D. Hamm.
In: Proceedings Poultry Waste Management Seminar, Athens, Georgia, June 23, 1970, p 16-22, 2 tab.

Descriptors: *Farm wastes, Poultry, Biochemical oxygen demand, Bacteria, *Food processing industry, Water utilization.
Identifiers: *Poultry processing plant.

A poultry processing plant (PPP) today is a ravenous user of clean water. Water usage per bird processed more than doubled during the 8 year period from 1957 to 1965 -- up from a 5 to 7 gallon average to a 12 to 15 gallon average. This means a total of 28 lbs of input or 36 lbs water per pound of edible product. Like all functioning biological systems, a PPP uses water to transport, disperse, and to regulate temperature. Parts and wastes are water flumed; water scalds the bird, washes it to disperse and transport wastes and debris; water cools it; and water cleans up the building and equipment. There are three general problem areas insofar as water in and from PPP's are concerned. The problems are: (1) how to cut down on volume; (2) how to reduce total waste loading; and (3) how to process the waste water before returning it to the environment. Research is needed to find ways to reduce the quantity required in poultry processing plants. (Bundy- Iowa State)

0719 - A9, B1, E3

FEEDING PROBLEMS ARISING FROM THE USE OF POULTRY LITTER ON PASTURES,
GEORGIA Univ., Athens. School of Veterinary Medicine.
D. J. Williams.
In: Proceedings Poultry Waste Management Seminar, Athens, Georgia, June 23, 1970. p 23.

Descriptors: *Farm wastes, Poultry, Cattle, Fescues, Pastures, *Animal diseases, Fertilizer, Waste disposal.
Identifiers: *Fat necrosis, Dead fat.

Cattle grazing on tall fescue heavily fertilized with poultry house waste may be developing a condition which tentatively has been called 'fat necrosis' or 'dead fat,' among other things. Postmortems on cows showed portions of the abdomen area covered with this very hard, chalky fat and in some instances this fat has completely closed the small intestines and surrounded kidneys, shutting off the urine process. Empirical evidence indicates that grain supplement 4-6 weeks prior to parturition prevents the development of this condition. (Bundy-Iowa State)

0720 - A9, B3, E3

PROGRESS REPORT: PASTURE FERTILIZATION USING POULTRY LITTER,
Agricultural Research Service, Watkinsville, Ga. Soil and Water Conservation Research Div.
S. R. Wilkinson, W. A. Jackson, R. N. Dawson, and D. J. Williams.
In: Proceedings Poultry Waste Management Seminar, Athens, Georgia, June 23, 1970, p 24-29, 6 ref.

Descriptors: *Farm wastes, *Waste disposal, Poultry, Litter, Fescues, Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, Fertility, *Animal diseases, Fertilizer.
Identifiers: Nitrate poisoning, Grass tetany.

Growing chickens and using the litter to produce extra grass and beef has been profitable. This practice has transformed the North Georgia countryside from eroded red clay to lush green grass by enhancing soil fertility, conservation, and wise land use. However, in some pastures where rates of litter applications have been high, animal health problems such as nitrate poisoning, grass tetany, and fat necrosis have appeared. The objectives were to produce under controlled and recorded conditions a tall fescue pasture heavily fertilized with broiler litter for the purpose of studying cumulative effects of high rates of broiler litter fertilization on selected soil, plant, and animal parameters in a grazing ecosystem; including the development of potential animal health problems of nitrate poisoning, grass tetany and fat necrosis. The research has not yet been completed, but the trends indicate that each ton of broiler house litter supplies about 60 lbs. of N, 30 lbs. of K, 30 lbs. of Ca, 8 lbs. of Mg, and is an important source of Zn, as well as micronutrients. The application of 14 tons of broiler house litter over a 365 day period has made some significant changes in soil chemical properties. Broiler manured fescue grass was consistently higher in total N than inorganic fertilized fescue except during the spring. (Bundy-Iowa State)

0721 - A3, A5, E2

HOW ENVIRONMENTAL PROBLEMS AFFECT FARM EQUIPMENT DESIGN,
Sperry Rand Corp., New Holland, Pa.
R. M. Alverson.
Agricultural Engineering, p 20-22, January 1971. 3 fig.

Descriptors: Farm wastes, Fertilizers, Odor, Runoff, Nutrients, Equipment, *Design, *Pollution abatement, *Environmental effects, *Farm equipment, Agriculture.
Identifiers: *Spreaders, Environmental trends.

The two most prevalent environmental trends in the U.S. today are the demands for 'clean' water and 'pure' air. These trends have been precipitated by both federal and state legislation. The Water Quality Act of 1965 (Public Law 89-234) was the first major federal legislation to force states to set minimum water quality standards and it established the Federal Water Pollution Control Administration. Future design consideration will include environmental quality concepts such as noise and vibration reduction and increased aesthetics. Future machines must also meet legal requirements for environmental protection. Design engineers should consider the trends of the environmental movement in every country where their products are sold. Legal rulings, if not aesthetic values alone, may soon require that farm equipment and procedures be non-polluting. For example, spreading manure on frozen or snow-covered ground causes a potential water pollution hazard. Odor problems with manure spreading are also prevalent. When manure is spread on the land, it may become mandatory to incorporate it into the soil. Fertilizer spreaders, pesticide applicators and tillage implements also create unwanted sources of nutrients, toxic chemicals and sediment. The environmental effects of these machines must be considered in their design. (Bundy-Iowa State)

0722 - C4

THE USE OF FLUORESCENT ANTIBODY TECHNIQUES FOR DETECTION OF STREPTOCOCCUS FAECALIS AS AN INDICATOR OF FECAL POLLUTION OF WATER,
North Texas State Univ., Denton. Dept. of Biological Sciences; and Clemson Univ., S.C. Dept. of Biological Sciences.
R. Abshire, and R. K. Guthrie.
Water Research, Vol 5, No 11, p 1089-1097, November 1971. 5 tab, 16 ref.

Descriptors: *Testing procedures, *Sampling, *Indicators, Streptococcus, Fluorescence, Water quality, Sewage effluents, Runoff, Water pollution sources, Bacteria, Pollutant identification.
Identifiers: *Fecal pollution, Streptococcus Faecalis, *Bacterial indicators.

A slide method for use of fluorescent antibody identification of Streptococcus faecalis is described. This method permits S. faecalis of fecal origin to be distinguished from those soil and water forms which are able to reproduce in water and sewage. Reactions were specific as confirmed by biochemical tests. Non-specific cross species fluorescence was readily removed by adsorption. Results indicate that this technique provides a method which will be useful in those pollution studies which require rapid identification and quantitation of organisms indicating fecal pollution. (Dorland-Iowa State)

0723 - E3

FEEDING VALUE OF CATTLE MANURE FOR CATTLE,
Auburn Univ., Ala. Dept. of Animal Science.
W. Brady Anthony.
Journal of Animal Science, Vol 30, No 2, p 274-277, 1970. 6 tab, 14 ref.

Descriptors: *Farm wastes, *Manure, Cattle, Feeds, Reuse.
Identifiers: *Cattle manure, Manure feeding, Manure utilization, Feed supplement.

The objectives were to reappraise the feeding of manure-containing rations to fattening cattle and determine if cooking the manure improved it's feeding value. Rations containing wet cattle manure were readily consumed by fattening steers and these rations supported gain essentially equal to comparable cattle fed feeds without manure. Cooking or washing manure before mixing it with concentrate for feeding did not improve its feeding value. Carcass data were similar for manure-fed and other cattle. Wet manure collected daily per yearling steer was about 13.5 kg. (3.12 kg. dry matter) and about 6.6 kg. (1.52 kg. dry matter) was consumed daily. The digestibility data do not clearly indicate effective use of either manure energy or manure crude protein. However the data show that manure did not impair digestibility and actually saved concentrate dry matter used per unit of gain. This indirect evidence strongly suggests that manure was utilized to an appreciable degree for productive purposes. Feeding manure with concentrate did not completely alleviate waste disposal problems. Only about one-half of the manure collected daily was fed. The remainder of the daily excretion had to be disposed of elsewhere. (Miner-Iowa State)

0724 - B2, E2

GUIDELINES TO LAND REQUIREMENTS FOR DISPOSAL OF LIQUID MANURE,
Guelph Univ. (Ontario).
L. R. Webber, T. H. Lane, and J. H. Nodwell.
In: Proceedings Eighth Industrial Water and Wastewater Conference, June 6-7, 1968, Lubbock, Texas. p 20-34, 1 fig, 4 tab, 19 ref.

Descriptors: *Farm wastes, Poultry, Confinement pens, Phosphorus, Potassium, Nitrogen, Crops, Landfills, Anaerobic digestion, Crop response, Rates of application, Fertilization.
Identifiers: *Stock piling, Incineration.

An intensification in the trend to raise livestock and poultry under high-density confinement housing has created problems in the disposal of liquid manures. Research is underway to produce guidelines that will assist producers in conforming to the pollution abatement laws in Ontario. The objectives are: (1) to set forth the accessible areas that producers must have for the utilization and disposal of liquid manure without causing water, air, or soil pollution; and (2) to test and to evaluate the guidelines by field and laboratory research and make, where necessary, revisions in the guidelines. Research has indicated that frequent and heavy applications of manure have resulted in a build-up in the soil of phosphorus and potassium without causing reductions in crop yield or contributing to the pollution of water supplied. A nitrogen balance for Ontario conditions is presented to show that crops of continuous corn or grass could be expected to utilize up to 300 lb N (from manure) per acre. Application rates greater than 300 lbs N/acre could lead to a depression of crop yield and cause water contamination. (Bundy-Iowa State)

0725 - A1, B3, E3

POLLUTION CONTROL IN CATTLE FEEDLOTS THROUGH USE OF MANURE AS FEED,
Auburn Univ., Ala. Dept. of Animal Science; and Alabama Agricultural Experiment Station, Auburn.
W. B. Anthony.
In: Proceedings Eighth Industrial Water and Wastewater Conference, June 6-7, 1968, Lubback, Texas, p 59.

Descriptors: *Farm wastes, Confinement pens, Cattle, Feeds, Food lots, Silage, Grains.
Identifiers: *Fresh manure, Wastelage.

Sanitation for cattle fed in confinement necessitates a satisfactory and economical means of disposing of manure. In initial tests, fresh manure was blended with a concentrate and fed to cattle from which it was collected. The blending ratio was 40 parts of manure and 60 parts of grain. Although the feeding of manure directly to the cattle from which it was collected proved to be not only possible but economically advantageous in terms of improved feed efficiency. Other ways of feeding cattle manure were investigated. The making and feeding of Wastelage evolved. Wastelage is made by combining feedlot manure with grass hay and storing the mixture in a silo. (Bundy-Iowa State)

0726 - A2, B2, F1

ECONOMICS OF WATER POLLUTION CONTROL FOR CATTLE FEEDLOT OPERATIONS,
Texas Tech Univ., Lubbock. Dept. of Agricultural Economics.
T. R. Owens, and W. L. Griffin.
In: Proceedings Eighth Industrial Water and Wastewater Conference, June 6-7, 1968, Lubbock, Texas, p 82-106. 10 tab.

Descriptors: *Farm wastes, Cattle, Feed lots, Economics, Runoff, Rainfall, Design, Costs, Water pollution control.
Identifiers: *High Plains.

One approach to the problem of water pollution from feedlots involved control of runoff by establishing collection basins and subsequently pumping the pollutant to an open land disposal area. A second suggested solution was a collection basin of sufficient size to hold polluted runoff until natural evaporation emptied the system. Data from secondary sources were used to develop the relationship between inches of precipitation and resultant runoff. Subsequently, design criteria were developed for various sizes of mechanical discharge and evaporative discharge collection systems. The various design criteria were then applied to three different sizes of feedlots, a 5000 head lot, a 10,000 head lot and a 25,000 head lot. Budgets were developed for each lot and for each system size and type, and total capital and annual operating costs were computed. The studies assumed that a part of the cost of operating any particular system would be the penalty imposed for overflow on the basis of current law, this penalty ranges from a minimum of $50/day to a maximum of $1000/day. The analysis of rainfall data provided an estimate of the number of overflows expected with any size and type of system. Thus, the cost of overflow was quantified by multiplying the number of overflows by the appropriate penalty rate. Finally, minimum cost systems providing only minimum overflow protection were compared with higher cost systems providing maximum overflow protection. Cost differences between the two systems were then evaluated to determine the increase in annual operating costs associated with additional protection. (Bundy-Iowa State)

0727 - A2, F5

EFFECTS OF AGRICULTURAL DISCHARGES INTO FRESH WATER LAKES,
Orange County Pollution Control Dept., Orlando, Fla.
C. W. Sheffield, and R. T. Kaleel.
In: Proceedings, Industrial Waste Conference, 25th, May 5, 6, and 7, 1970. Purdue University Engineering Extension Series No. 137, Part 2, p 904-913, 5 fig, 4 tab, 4 ref.

Descriptors: *Drainage effects, *Denitrification, *Eutrophication, Runoff, Nutrients, Bottom sediments, Drainage water, Nitrates, Water management, Peat, Phosphates, Dikes, Canals, Nitrification, Water pollution sources.
Identifiers: *Pumping discharge, Surface leaching, Nutrient removal.

Agricultural business has increased along with demands for its products. In the United States most winter and spring vegetable crops are grown in the warmer climates of Florida, Texas, Arizona, and California. To obtain crop growth needed for maximum production, land irrigation must be practiced. In Florida most of this farming is on peat soil that was at one time lake bottoms. Land of this nature is either developed naturally or reclaimed by man through diking and canaling systems. The effects of agricultural discharges on receiving waters are discussed, including what is being discharged chemically and how it changes the chemical, physical, and biological characteristics of the receiving fresh water lakes. The effects of nutrients into a lake are difficult to ascertain due to the effects of other nutrient sources such as sewage treatment plants, bottom recycling, rainfall, runoff, and surface leaching. However, there is a definite need to reduce turbidity, nutrients, and solids concentration in pumping discharge. (Dorland-Iowa State)

0728 - A5, B1, D4

ODORLESS PORK PRODUCTION: FROM CONCEPTION TO MARKET,
Smart (Paul) Hog Farm, Lawrence, Kans.; and Kansas Univ., Lawrence. Dept. of Civil Engineering.
P. Smart, and R. E. McKinney.
In: Proceedings, Industrial Waste Conference, 25th, May 5-7, 1970, Purdue University, Engineering Extension Series No. 137, Part 2, p 757-760, 4 ref.

Descriptors: *Farm wastes, *Aerobic treatment, *Waste treatment, Hogs, Aeration, Confinement pens, Activated sludge, Biochemical oxygen demand, Rotors, Odor, Anaerobic conditions.
Identifiers: *Swine confinement, Concrete slats, Mechanical breakdown, Oxidation ditch.

The world is faced with an ever-increasing population and an ever-increasing food demand. One of the most critical food demands is for high quality meat protein. It has been possible to meet the pork needs without intensified animal growing. But the future indicated that a change was needed. In the summer of 1965, a project began to take shape that was to result in a major hog growing operation which would set the pattern for a new concept in producing pork. It was proposed that a complete animal confinement system be constructed near Lawrence, Kansas, which would yield 10,000 marketable hogs per year. This confined hog system was designed to provide the optimum environment for the animals from conception to market. One thing was apparent; no one had fully solved the problem of manure disposal. Odor nuisances created by hog manure, especially during removal and spreading, required location a considerable distance from other people. Biological concepts employed in wastewater treatment systems provided the answers needed to solve the hog manure disposal problem. The system employed a system of aerobic treatment under slotted floors. (Dorland-Iowa State)

0729 - A5, B1, D3

DESIGN AND OPERATION OF A PILOT PLANT FOR COMPOSTING POULTRY MANURE,
Guelph Univ. (Ontario). Dept. of Microbiology.
R. G. Bell, and J. Pos.
Transactions of the American Society of Agricultural Engineers, Vol 14, No 6, p 1020-1023, Nov-Dec 1971. 6 fig, 6 ref.

Descriptors: *Farm wastes, Odor, *Poultry, *Waste treatment, Runoff, Air pollution, *Pilot plants, Aeration, Operation, Design.
Identifiers: *Composting.

A pilot plant for composting poultry manure is described. The composting unit consisted of a closed cylinder mounted on a steel frame, fitted with an internal rotor driven by an electric motor through a power train. Air was supplied by a fractional horsepower air compressor and was introduced into the composter through three manifold lines. Poultry manure can be composted, but the real question is whether composting reduces the pollution potential from poultry waste. The compost as discharged from the pilot plant was dark brown in color, had a nitrogen content of between 1.3 and 1.5 percent (dry wt. basis), a moisture content near 50 percent and a strong smell of ammonia. The compost did heat up which was an indication that the material was not stabilized. Even after being left unattended for several months, compost piles did not develop objectionable odors nor was there evidence of appreciable runoff during heavy rain storms. From these observations, it is concluded that composting does reduce the pollution potential of poultry manure and would, therefore, be a satisfactory way to treat manure prior to prolonged storage. (Bundy-Iowa State)

0730 - A4, C3, E1

AGRICULTURE'S EFFECT ON NITRATE POLLUTION OF GROUNDWATER,
Agricultural Research Service, Fort Collins, Colo.
B. A. Stewart, F. G. Viets, Jr., and G. L. Hutchinson.
Journal of Soil and Water Conservation, Vol 23, No 1, p 13-15, January-February, 1968. 1 fig, 1 tab, 8 ref.

Descriptors: *Nitrate, *Water pollution, *Fertilizers, *Soil profiles, *Groundwater, *Agriculture, *Wastes, Alfalfa, Grasslands, Feedlots
Identifiers: Irrigated row crops, Domestic wells.

Contributions of fertilizers applied to soil and wastes from concentrated livestock feeding operations to pollution of groundwater were studied in the middle South Platte River Valley in Colorado. Amounts of nitrate moving through 129 soil profiles varied widely with land use. Average total nitrate N to a depth of 20 ft in lbs/acre was 1436 under feed-lots, 506 under irrigated row crops, 261 under dryland row crops, 90 under native grassland, and 79 under alfalfa. The average annual loss of N to groundwater under irrigated row crops was estimated at 25-30 lbs/acre. Feedlots located near homesteads had much more effect on nitrate content of water from domestic wells than did cropped land. (Skogerboe-Colorado State)

0731 - B1, C5, E3

DISPOSING OF ANIMAL WASTES,
Washington State Univ., Pullman.
D. O. Turner.
Crops and Soils Magazine, p 10-11, February 1971.

Descriptors: Farm wastes, Dairy industry, Lagoons, Fertilizers, Runoff, *Waste disposal, *Washington, *Waste treatment, Water reuse.
Identifiers: Urban expansion.

Handling wastes from dairy and beef operations is difficult. In Washington, a system was designed to handle the wastes from approximately 400 dairy cattle. The location was an alluvial flood plain which was subject to frequent and severe winter flooding. The wastes from the herd were scraped and flushed to a transfer pump where they could go directly to the fields or to the two winter storage lagoons, each of which have a capacity of one million gallons. Waste material from the lagoon was transported through a pipeline and applied to silage corn and ryegrass with a sprinkler. Application was limited because of a thatch from by the fiber content of the manure which allowed surface runoff. Current recommendations are that dairymen should have one acre of disposal land for every two cows. (Bundy-Iowa State)

0732 - D4, E2

CLOSED SYSTEMS FOR ANIMAL SEWAGE TREATMENT,
Massachusetts Univ., Amherst. Water Resources Research Center.
J. T. Clayton.

Completion Report FY 72-7, 1971. 11 p, 22 ref.
OWRR A-009 MASS (4).

Descriptors: *Farm wastes, *Treatment facilities, Dairy industry, *Waste treatment, Sub-surface irrigation, Tertiary treatment, Cattle, Solid wastes, Water reuse, *Waste disposal, Aerobic treatment.

Stationary sloping screens were used to remove up to 75% of the solids in diluted dairy cattle manure. Two bench-scale aerobic treatment systems were then used to treat screened effluent. Two replicate systems, one using distilled water and one using system final effluent to dilute incoming manure were used to determine the effects of renovated water reuse. BOD reductions greater than 95% and COD reductions greater than 90% were obtained in all systems. No adverse effects of water reuse were found. Phosphate level was not affected and there was no appreciable build-up of fecal coliform or fecal streptococcus. A one-cow scale modified activated sludge system was used to treat 120 pounds of manure and 66 gallons of dilution water daily for more than six months. The final effluent was disposed of by a sub-surface irrigation system. Plastic nozzles were found satisfactory to release the liquid to the soil. BOD and COD were further reduced by about 95% in the tertiary treatment system (soil). Best performance was obtained in the two treatments in which activated sludge effluent was periodically applied to the soil.

0733 - A2, B1, D1, E1

ALTERNATIVES FOR WASTE MANAGEMENT FOR OPEN BEEF FEEDLOTS,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
A. F. Butchbaker, J. E. Garton, G. W. A. Mahoney, M. D. Paine, and A. Wetmore.
Paper number SWR 71-403 presented at 1971 Annual Meeting Southwest Region of the American Society of Agricultural Engineers, Sequoyah State Park, Oklahoma. April 1-2, 1971. 20 p, 3 fig, 1 tab, 16 ref. FWQA Grant 13040 FXG.

Descriptors: *Farm wastes, *Runoff, *Solid wastes, Confinement pens, Disposal, Farm lagoons, *Waste disposal, Cattle, Cost comparisons, *Waste storage, *Design criteria, Feedlots.
Identifiers: *Cattle feedlots, Runoff treatment, Mechanical removal.

During the 1960's, the number of fed cattle marketed in the United States increased from 13 million to 25 million. This increase in fed cattle produced resulted in a corresponding increase in waste production. Daily manure production of a beef animal is about 6% of his body weight. The object was to develop open beef feedlot design criteria to minimize pollution from runoff wastes and to facilitate handling of solid and liquid animal waste and to examine alternative feedlot waste disposal systems to determine minimum cost systems for effective waste disposal. Six systems of waste handling were investigated; tractor loader and dump truck, commercial loader and dump truck, tractor loader and pull spreader, commercial loader and spreader truck, rotary scraper, and an elevating scraper. Several types of runoff control systems were also investigated; solids settling and detention, solids settling and lagoon, detention and lagoon, detention pond only, broad base detention, and batch detention. The characteristics of the solid waste material and the changes it undergoes during storage in a feedlot were also studied. (Dorland-Iowa State)

0734 - A3, C5, D1

CATTLE FEEDLOT WASTE PROBLEMS,
Kansas State Univ., Manhattan.
R. I. Lipper, J. R. Miner, and G. H. Larson.
Paper presented at Oklahoma Cattle Feeders Seminar, February 2-3, 1967, Stillwater, Oklahoma. 9 p, 5 ref.

Descriptors: *Farm wastes, *Feed lots, Runoff, *Sprinkler irrigation, Water pollution, Cattle, *Kansas, Coliforms, Water reuse.
Identifiers: *Impounding.

Cattle feedlot runoff became recognized as a problem in Kansas during the late 1950's. Incidents of septic streams and fishkills were noted immediately following rainfall in areas where no known municipal of industrial waste discharges existed, and where chances of insecticide and herbicide residues seemed remote. To study feedlot runoff, two experimental feedlots were constructed. One was entirely surfaced with concrete; the other had concrete only around feed bunks. Rather than wait for natural storms, simulated rainfall was provided through six part-circle irrigation sprinklers spaced at the periphery of the lots. The first method for control of runoff to be studied involves impounding the runoff water until it can infiltrate adjacent land without producing further runoff. New animal research facilities are being planned at Kansas State University. Funds are being sought to incorporate research systems for processing total waste production from animals reared in several covered pens with concrete floors. Hopefully results will be used in setting standards for cattle feedlots. (Bundy-Iowa State)

0735 - C2, C3, C4, D4

SECONDARY TREATMENT OF HOG WASTE IN AN ANAEROBIC STABILIZATION POND,
North Dakota Water Resources Research Inst., Fargo.
Robert G. Butler.
North Dakota Water Resources Research Institute Report WI-221-011-69, December, 1969. 35 p, 4 fig, 11 tab, 44 ref. OWRR Project A-010-NDAK (1).

Descriptors: *Anaerobic conditions, Biochemical oxygen demand, *Oxidation lagoons, Farm wastes, *Bacteria, Waste water treatment, *Anaerobic bacteria, Photosynthetic bacteria, Microorganisms, Chemical analysis.
Identifiers: *Hog wastes.

This study relates the physical and chemical characteristics of the contents of an anaerobic stabilization lagoon to the bacteria that are responsible for the stabilization of the waste. The lagoon is fed by effluent from a settling tank that receives wastes from a hog barn. The lagoon operated as an unheated digester and maintained a pH between 7.2 and 8.1. The Redox potential varied from -370 to -403 millivolts. The mean concentration of volatile acids was 403 mg/l. The average level of BOD for the lagoon water was 566 mg/l. A BOD loading of 3,250 pounds per acre per day did not produce lagoon failure. Sulfate reducers were grown on Postgate's Media E. Methane producing organisms were detected. Photosynthetic organisms were grown on two different media.

0736 - A9, C4, E1

SALMONELLA IN WASTES PRODUCED AT COMMERCIAL POULTRY FARMS,
Rutgers - The State Univ., New Brunswick, N.J.
D. J. Kraft, Carolyn Olechowski-Gerhardt, J. Berkowitz, and M. S. Finstein.
Applied Microbiology, Vol 18, No 5, p 703-707, November 1969. 4 tab, 13 ref.

Descriptors: *Salmonella, *Poultry, Bacteria, Sampling, Pathogenic bacteria, Waste disposal, Farm wastes.

The potential of poultry excreta and manure from commercial farms to contaminate the environment with salmonella was determined. Composite samples of freshly voided excreta from 91 poultry houses were tested qualitatively for salmonella. Twenty-six (29%) were positive. Of the 36 farms tested, 18 showed positive samples. In a separate quantitative study salmonella densities ranged from less than 1 to over 34,000 per gram excreta (dry weight). Those samples from floor and caged birds were comparable with respect to the incidence of salmonella. As shown in a qualitative survey there were distinct differences. High densities of the pathogens were found in fresh excreta from caged but not floor birds. It is concluded that the spreading of these wastes could have disseminated substantial numbers of salmonella onto the soil possibly lending to the contamination of water via surface run-off. It is suggested that the recently developed plow-furrow-cover method of manure application may be advantageous in burying the waste thereby preventing its transport by surface run-off. (Hancuff-Texas)

0737 - C3, D4

REDUCTION OF NITROGEN CONCENTRATIONS IN SWINE LAGOON EFFLUENT BY BIOLOGICAL DENITRIFICATION,
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
J. K. Koelliker, and J. R. Miner.
In: Proceedings, Industrial Waste Conference, 25th, May 5-7, 1970, Purdue University, Engineering Extension Series No. 137, Part 1, p 472-480, 6 tab, 11 ref. PHS Grant EC 00283-02.

Descriptors: *Farm wastes, *Denitrification, *Biological treatment, Hogs, Liquid wastes, Effluents, Nitrogen, Anaerobic conditions, Irrigation, Lagoons, Aerobic conditions, Oxidation-reduction potential, *Waste treatment, Waste disposal.
Identifiers: Carbon source, Anaerobic lagoons.

Conventional schemes that treat liquid animal wastes are designed to reduce organic material and to reduce solids volume before final disposal. Removal of nitrogen by such operations is incidental. If such lagoon effluent were released into the environment, problems would arise from the quantities of nitrogen remaining. Because of these problems, or potential problems, with irrigation disposal of anaerobic swine lagoon effluent, a study was undertaken to explore the feasibility of reducing nitrogen concentrations before disposing of the effluent. Reduction of nitrogen concentration by biological denitrification is discussed. The conditions necessary for denitrification are a source of NO3-N, an available organic carbon energy source, a population of denitrifying bacteria, pH 5-9, little or no molecular oxygen, and temperature 5-60 degrees C. There is not sufficient organic carbon in a well-nitrified swine waste effluent, however, adding raw swine manure at a feed rate of BOD5 = 3.26 NO3-N gives an efficiency of nitrogen removal of 91 percent. (Dorland-Iowa State)

0738 - A3, B1

MODELING FEEDLOT RUNOFF POLLUTION I. ANALOG SIMULATION,
Kansas State Univ., Manhattan. Dept. of Chemical Engineering.
S. F. Kang, L. T. Fan, E. S. Lee, and L. E. Erickson.
Transactions of the American Society of Agricultural Engineers, Vol 13, No 6, p 858-869, Nov-Dec 1970. 11 fig, 3 tab, 26 ref. FWPCA WP-0141-02.

Descriptors: *Farm waste, Confinement pens, Computer model, Analog computer, Analog models, Simulation analysis, Runoff, Water pollution, Infiltration, Cattle.
Identifiers: *Dimensional analysis, Dynamic modeling, Feedlot.

The purpose of the investigation outlined is to investigate (feedlot runoff) a more realistic model; namely, a dynamic model represented by a set of nonlinear differential equations using analog computer simulation. Since the feedlot runoff system does not generally remain at steady state, a dynamic model can represent the system more realistically than a static model. For a system of three parameters, fitting data by an analog simulation can be used effectively when high accuracy is not required. However, for a complex system with a large number of unknown parameters, the analog simulation approach can be very tedious and time consuming. The quasi-linearization technique is shown to be a useful tool for estimating parameters in a feedlot runoff system. The advantage of the quasilinearization technique is that, if the process converges, it converges quadratically. This technique has been proved useful not only in parameter estimation, but also in solving nonlinear boundary value problems in partial and ordinary differential equations. The quasilinearization technique also has disadvantages; two of the most important ones are the ill-conditioned problems and the convergence problem. (Bundy-Iowa State)

0739 - A4, A9, C3

NITRATE AND WATER,
Missouri Univ., Columbia. Dept. of Soils.
M. Christy, J. R. Brown, and L. S. Murphy.
Science and Technology Guide, University of Missouri Extension, Columbia, p 9808-9809, March 1965, 2 fig, 1 tab.

Descriptors: *Farm wastes, Nitrogen, Fertilizers, Legumes, Missouri, Alfalfa, Livestock, *Water pollution sources, *Nitrates, *Public health.

Nitrates in some water supplies have caused concern. A statewide survey showed that animal manures, inadequate sewage systems, and soil organic matter comprised the primary sources of nitrate in water supplies. Even though nitrate has been found in shallow wells all over the state, the largest percentage of such wells have been found in areas with greatest livestock numbers. Other sources include the nitrogen from legumes and fertilizers. Ponds usually have a low nitrate level. On the other hand, water of springs contains nitrate, thought to originate from natural soil leachings and bat guano deposits in nearby caves. The annual flow of some large springs may contain many times more nitrate-nitrogen than the total fertilizer nitrogen used annually in Missouri. The reason for concern is potential health hazards. Nitrate can be especially hazardous to infants. One problem is that boiling will not remove nitrates. (Bundy-Iowa State)

0740 - B1

PHOTOGRAPHIC STUDIES OF THE DUNGING BEHAVIOR OF PIGS IN CONFINEMENT,
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
J. F. Hultgren, and T. E. Hazen.
Paper number MC 71-101 presented at the 1971 Mid-Central Meeting of the American Society of Agricultural Engineers, St. Joseph, Missouri, April 16-17, 1971. 15 p, 5 fig, 1 tab, 10 ref.

Descriptors: *Farm waster, *Animal behavior, *Design criteria, Hogs, Training, Environmental effects, Light intensity, Temperature, Photography, Confinement pens, *Odor.
Identifiers: Dunging behavior, Time-lapse photography, Statistical analysis.

Each year in the United States, an increasingly larger volume of hogs are produced in confinement. Greater and greater emphasis is being placed on the control of offensive odors. Pen and pig cleanliness are important in odor control. Both are largely dependent on defecation behavior and feces placement. A research project was initiated to determine if pigs had a predictable defecation pattern and what housing design factors might influence this behavior. Time-lapse photographic observations on 180 pigs indicated that they spend an average of 81.1 percent of each 24-hour period sleeping, 7.6 percent standing, 10.0 percent eating, 0.9 percent drinking, and 0.4 percent defecating. Tested for effect on the dunging behavior were 3 levels each of air temperature and lighting, and 3 locations of air placement. When statistically analyzed, the treatment differences were seldom significant. The pigs developed some established activity patterns, however, which provide a basis for improved building design and sanitation. (Dorland-Iowa State)

0741 - A2, B1, F2

RULES AND GUIDELINES FOR THE CONTROL OF WATER POLLUTION FROM LIVESTOCK CONFINEMENT FACILITIES AND GUIDELINES FOR CONSTRUCTION OF SEALED EVAPORATION AND RETENTION PONDS.

Colorado Department of Health, Water Pollution Control Commission, Denver, April 10, 1968, 11 p, 3 fig.

Descriptors: *Farm wastes, Feed lots, Confinement pens, *Colorado, Lagoons, Regulation, *Water pollution control.

The Colorado Water Pollution Control Commission established rules for the prevention of water pollution from livestock confinement facilities in the state of Colorado. Guidelines established by the commission are included. Some of them pertain to preliminary considerations, pond surface area, pond storage volume, discharge and percolation, and pond shape, pond fencing and maintenance, land disposal system, embankments and dikes, pond bottom settling tank and biological treatment. (Wallin-Iowa State)

0742 - A9, C4

INFECTIOUS PANCREATIC NECROSIS VIRUS: COMPARATIVE FREQUENCIES OF ISOLATION FROM FECES AND ORGANS OF BROOK TROUT (SALVELINUS FONTINALIS),
Guelph Univ. (Ontario). Dept. of Veterinary Microbiology and Immunology.
C. Frantsi, and M. Savan.
Journal of the Fisheries Research Board of Canada, Vol. 28, No. 7, p 1064-1065, 1971. 1 tab, 4 ref.

Descriptors: *Fish diseases, *Brook trout, *Viruses, Trout, Fish, Bacteria, Fish hatcheries, Fisheries, Fish management, Pollutant identification.
Identifiers: *Stress, Feces, Organs, Infectious pancreatic, *Necrosis virus.

When isolation of infectious pancreatic necrosis (IPN) virus was attempted simultaneously from feces and organs of brook trout, the virus was isolated more frequently from organs than from feces. However, the greater the degree of stress on the fish, the closer the number of isolations from feces appeared to approach that from organs, and the virus was isolated from both organs and feces of each of 10 fish accidentally exposed to low oxygen concentration for 4 days. The findings suggest that masked viral and bacterial infections may be detectable if fish are plaed under stress. (Dorland-Iowa State)

0743 - B1, F1

GUIDELINES FOR DEVELOPING COMMERCIAL FEEDLOTS IN KANSAS,
Kansas State Univ., Manhattan. Cooperative Extension Service.
D. B. Erickson, and P. A. Phar.
Kansas State University, Cooperative Extension Service, Number C-418, (April 1970). 30 p, 2 fig, 20 tab, 15 ref.

Descriptors: *Farm wastes, *Feed lots, Cattle, Economics, Irrigation, Feeds, Runoff, Kansas, Cost analysis.

Guidelines are provided on costs of financing and constructing feedlots. The development of large feedlots handling 10,000, 20,000 and 30,000 head has been inspired by economics of scale and very favorable cattle and feed prices. The average investment for a 10,000 head capacity lot would be about $43.15 per head, while for a 30,000 head capacity lot the requirements drop to about $33.87 per head. The total feed and operating cost per head for each size feedlot is: 10,000 head - $85.36; 20,000 head - $83.89; 30,000 head - $82.24. The expansion of the large feedlots in Kansas will depend on the availability of feed, water, labor and cattle. Some areas will have the capacity to expand faster than others depending on existing grain production and development of irrigation. Shipping grain a considerable distance adds to cost of production. Knowledge of the number of cattle and hogs to be fed, crop production and the location of the market that will return the greatest income to the cattle owners is necessary for an assessment of the local potential for a feedlot. Expansion of the packing industry areas where feeding is increasing creates a greater opportunity for producers to sell their cattle. (Bundy-Iowa State)

0744 — A1, F3, F5

ANIMAL SLAUGHTER AND PROCESSING,
National Industrial Pollution Control Council, Washington, D. C.
S. S. Cross, R. W. Renaker.
Animal slaughtering and Processing National Industrial Pollution Control Council, Sub-Council Report February, 1971. 14 p.

Descriptors: *Farm Wastes, *Industrial Wastes, Air Contamination, Solid Wastes, Wastewater Regulations, By-Products.
Identifiers: *Rendering, Animal Processing Wastes, Poultry and Animal Products.

The United States poultry and animal products Industries include approximately 7,500 establishments. The pollution problems of these industries cover the normal range of water, air and solid pollutants. Substances collected in the process water include organic matter from blood, meat, or paunch contents, fats, oils, grease, nutrients, and dissolved inorganic solids. The rendering industry considers objectionable odors from edible and inedible rendering operations as its primary pollution problem. Ground manure is the principal solid waste from feedlot operations. New technology is needed to develop' a standard water sampling procedure, design a program to identity where nutrient losses are occuring in processing operations, and design a program to study the effects of reduced water usage. The poultry and livestock - based industries have long demonstrated an awareness and a concern for environmental problems and have voluntarily initiated programs to develop corrective procedures. Government policies should continue to encourage and assist these industries in the identification and solution of major pollution problems. (Schmitt - ISU).

0745 - F4

ANIMAL WASTES.
National Industrial Pollution Control Council, Washington, D.C. Staff Report, February 1971. 15 p, 1 fig, 2 tab, 9 ref.

Descriptors: *Farm wastes, *Industrial wastes, Flow control, Byproducts, Waste storage, Pollution abatement, Water pollution sources.
Identifiers: *Animal processing wastes, Rendering.

Increased pollution from animal wastes is attributable to two of the fundamental factors behind most pollution problems -- population increase and the adoption of more efficient production or processing methods. Farm animals produce over one billion tons of fecal wastes and 400 million tons of liquid excrement per year, with a human population of BOD equivalent of over 2 billion persons. Animal processing wastes frequently include blood, paunch contents, and clean-up materials. Only about 40% of a beef animal slaughtered for human food is considered edible. The rendering process, which involves the cooking of various types of carcass materials, is a significant source of pollution. Remedial actions being undertaken to deal with the animal waste problem include construction of water diversion structures around livestock feedlots and excrement collection in large storage tanks for later return to the land. Currently, research is under way to assess the use of chicken litter as a feed for ruminants. Pollution control in the meat packing industry is largely a matter of by-product recovery. Blood recovery, paunch handling, edible rendering, inedible rendering, and clean-up are the five key recovery processes. Completely enclosed animal factories with complete control of inputs and outputs are expected to become a reality in the not too distant future. (Schmitt-Iowa State)

0746 - D4, E3, F1

RECYCLING SYSTEM FOR POULTRY WASTES,
Lake Tahoe Area Council, Tahoe City, Calif.
G. L. Dugan, C. G. Golueke, and W. J. Oswald.
Journal Water Pollution Control Federation, Vol. 44, No. 3 p 432-440, March 1972, 3 fig, 2 tab, 9 ref.
EPA Grant 5R01 U100566-03.

Descriptors: *Farm wastes, Poultry, Nitrogen, Lagoons, Pumping, Aerobic treatment, Biochemical oxygen demand, Chemical oxygen demand, Nutrients, *Waste treatment, *Algae, Costs.
Identifiers: *Oxidation ditch, Hydraulic manure handling.

An integrated waste management system was developed in which animal enclosure sanitation was integrated with waste treatment. It was a largely closed hydraulic system involving an anaerobic phase and an aerobic phase in which oxygenation could be accomplished either by the photosynthetic activity of algae or by mechanical aeration. When photosynthetic oxygenation was used, algae were harvested. The range of application of the process is from small-scale to large-scale operations. Algae reclamation would be practiced in large-scale operations and induced aeration in smaller ones. An important operational feature of the system is to keep the solids content of the manure slurry to less than 3 percent, wet weight. At concentrations of 3 percent or less, 70 percent or more of suspended solids in manure slurries settle out of suspension in less than 30 min. Pond depth should not exceed 12 in. (30.5 cm). The indicated pond area per bird was 2 sq. ft. (0.19 sq. m.). An economic evaluation based on an integrated system of 100,000 egg layers and the application of the low-loading, high-cost, and over-designed components used in the research indicates that the waste-handling costs of the system would be at the most, $0.02/dozen eggs. If the value of the algal crop were credited to the operation, the net waste-handling cost would be about $0.01/dozen eggs. (Bundy-Iowa State)

0747 - B1

ALTERNATIVES IN CATTLE FEEDLOT WASTE MANAGEMENT,
Iowa Univ., Iowa City. Dept. of Civil Engineering.
R. R. Dague.
In: Proceedings, Industrial Waste Conference, 25th, May 5-7, 1970, Purdue University, Engineering Extension Series No. 137, Part 1, p 258-265, 1 fig, 17 ref.

Descriptors: *Farm wastes, *Waste treatment, *Design criteria, Runoff, Waste water disposal, Waste water treatment, Waste disposal, Physical properties, Chemical properties, Biological properties, Control systems, Economic feasibility, By-products, *Feed lots, Cattle.
Identifiers: Population equivalents, Pollution potential.

In the 32 leading cattle-feeding states there are about 200,000 cattle feedlots. In 1967, the 22 million cattle produced in these feedlots produced about 200 million lb/day (dry weight) of manure. The control practices employed in a given region or state may be necessary and effective in that area but be unnecessary or ineffective in another area. The form of the wastes as they enter the environment may bear only a slight resemblance to what they are like when fresh. The manure accumulation on the feedlot surface is one waste--the runoff is another. The expression of animal waste quantities in terms of human population equivalents is very misleading, the important factor is the amount and characteristics of the material that actually enters the stream. The steps that should be involved in solving feedlot waste problems are: (1) Can the waste volume and/or strength be reduced at the source. (2) Can the physical, chemical, and biological characteristics of the waste be improved at the source. (3) Is it possible and feasible to recover by-products from the waste. (4) What systems will most economically accomplish the necessary degree of waste control or treatment. Management of the manure and the runoff are discussed. (Dorland-Iowa State)

0748 - A5, A6, C3, D4

THE ELIMINATION OF ODOUR FROM THE EFFLUENT GASES OF CHICKEN MANURE DRYING PLANT,
Loughborough Univ. of Technology (Ontario).
A. S. Hodgson.
Journal Agriculture Engineering Research, Vol. 16, No. 4, p [illegible]37-393, December 1971, 3 fig, 1 ref.

Descriptors: *Farm wastes, *Poultry, *Odor, Dehydration, *Drying, Feed, *Waste treatment.
Identifiers: Pilot experiment, Waste gas, Scrubber, Cyclone separator.

Practical means of reducing odor from a [illegible] manure drying plant waste gas stream was investigated. The cause of the odor and possible means of removal from the waste gas were studied. Although odor removal was possible, the cost is high. The problem should be considered during the plant design stage. A chicken manure drying plant must be designed initially with the problem of effluent gas odor of primary importance. For the plant studied, operation was consistent with the operating manual. Recycle rates were lower than expected which may increase the odor problem. The odor in the gas stream from the chicken manure plant is caused by ammonium salts of carboxylic acids, free acids and neutral material and possibly other material. The drying of chicken manure must be accomplished in a system which does not produce gaseous effluent with strong odor. The ultimate result of not considering the odor problem at the initial design stage is to risk having the plant shut down as a public nuisance. A closed system is probably the only satisfactory method for overcoming this problem. Modifications to a plant for odor removal are difficult and expensive. (Bundy-Iowa State)

0749 - A5, B2, D4

ROTOR AERATION OF SWINE WASTES,
Illinois Univ., Urbana. Dept. of Agricultural Engineering.
D. L. Day, J. C. Converse, and D. D. Jones.
Illinois Research, University of Illinois Agricultural Experiment Station, p 16-17, Spring, 1968, 4 fig.

Descriptors: *Farm wastes, *Oxidation, Aeration, Hogs, Gases, Odors, Confinement pens, Ammonia, *Waste water treatment, Costs, Waste treatment.
Identifiers: *Oxidation ditch, Foaming, Rotor aeration.

Laboratory tests on aeration of hog wastes indicated that it might be feasible to develop an oxidation ditch in a confinement swine house. With this method, self-cleaning slotted floors could be used without objectionable gases and odors coming from the gutter. Eighty pigs averaging 120 pounds were used. The gutter was filled with tap water, and 100 gallons of activated sludge from the Urbana waste-treatment plant was added as an inoculum at the beginning of the test. The major problem was foaming which began during the fifth week of operation. On the basis of an electricity rate of 2 cents per kilowatt hour, the power to furnish the proper oxygen supply costs about a half a cent per pig per day. During the second test, a rotor with a 3/4-horsepower motor was used to supply 0.9 pounds of oxygen per pig per day. Foaming was not as serious as during the first test. On the second test, an ammonia odor was very evident in the building, and appeared to be coming from the aerated waste. This odor subsided, however, during the ninth week and did not recur. Before the oxidation ditch can be unconditionally recommended for swine confinement buildings, several problems must be solved. The most immediate of these is the control of foaming. (Bundy-Iowa State)

0750 - D4

LAGOONING OF LIVESTOCK WASTES IN SOUTH DAKOTA,
South Dakota State Univ., Brookings. Dept. of Civil Engineering.
J. N. Dornbush, and J. R. Andersen.
In: Proceedings, Industrial Waste Conference, 19th, 1964, Part 1, p 317-325, 2 fig, 2 tab, 8 ref.

Descriptors: *Farm wastes, *Lagoons, Anaerobic conditions, Aerobic conditions, Poultry, Biochemical oxygen demand, Chemical oxygen demand, Ammonia, Nitrogen, *South Dakota, Waste water treatment.
Identifiers: *Dry solids, Volatile solids, Cages.

Current studies of lagoons in South Dakota have elucidated some of the basic factors influencing the design and operation of farm manure lagoons in a northern climate. To serve as an economical final method of disposal of farm manures, the lagoons must maintain anaerobic biological action and should be loaded on a volatile solids (VS) basis as are other sludge digesters. A loading rate of five to 10 lbs of VS per 1,000 cu. ft. of lagoon volume has been found satisfactory where winter conditions result in storage of manures for prolonged periods. Mixing the lagoon contents to disperse sludge deposits appears essential to avoid offensive odors. An adequate water depth to facilitate mixing is desirable and lagoon depths of five to eight ft. warrant consideration. (Bundy-Iowa State)

0751 - E3, F4

ANIMAL WASTE VALUE-NUTRIENT RECOVERY AND UTILIZATION,
Alabama Agricultural Experiment Station, Auburn. Dept. of Animal Sciences.
W. B. Anthony.
Journal of Animal Science, Vol. 32, No. 4, April 1971, p 779-802, 46 ref.

Descriptors: *Farm wastes, *Poultry, Swine, Cattle, Feed lots, *Waste treatment, *Waste disposal.
Identifiers: *Packing house wastes.

Livestock organic waste far exceeds the organic waste output of the human population in the United States. Livestock waste can be converted into a great resource but most waste management research is concerned with humans. However, some research has been done on using poultry waste as a feed or feed component. Tests have been made on the feeding of autoclaved poultry manure (APW), cooked poultry manure (CPW), and soybean meal (SBM) to wethers and steers. Poultry manure has also been used indirectly for chick feed. In Britain, the feeding of poultry manure to sheep and cattle seems to have been widely accepted. In addition to poultry, waste management research has been carried out on pigs and cattle. Dried pig feces have been inserted into swine finishing rations and have been fed to swine. Steer manure has been an acceptable component of swine rations and in recent years has also been used for cattle feeding. The feeding of steer manure to cattle has proven satisfactory because it (1) largely eliminated noxious accumulation of manure in the feedlot, and (2) improved the efficiency of the cow as a converter of feed to human food. To avoid harvesting steer manure each day to blend with the grain prior to feeding, the wastelage concept was developed. Wastelage is the conversion of feedlot manure into silage. Manure may also be made useful for feed by yeast fermentation or by lactic acid fermentation. (Bundy-Iowa State)

0752 - B1, F1

ROLE OF THE SOIL CONSERVATION SERVICE IN DESIGN OF FEEDLOT WASTE MANAGEMENT FACILITIES,
Soil Conservation Service, Lincoln, Neb.
D. R. Vallicott.
(1970), 2 p.

Descriptors: *Farm wastes, *Design criteria, Construction costs, Cost sharing, *Standards, Runoff, Government supports.
Identifiers: *Feedlot runoff, *Soil Conservation Service, Runoff control.

The Soil Conservation Service works with farmers and ranchers in the planning and installation of soil and water conservation practices on their farms or ranches and, since feedlot runoff control can be effected by the installation of a system of conservation practices, it comes within the scoope of Soil Conservation Service responsibility. Assistance to the farmer or rancher comes from three sources: the Extension Service, the Soil Conservation Service, and the Agricultural Stabilization and Conservation Service for cost sharing where applicable. The Soil Conservation Service has, based on its knowledge in the design and performance of certain conservation practices, prepared an Engineering Standard and Specification for what has been termed 'Feedlot Runoff Control'. The standard has been prepared using what are considered proven methods and procedures. It is anticipated that improvements will be made as other methods and procedures are proven to be sound. (Dorland-Iowa State)

0753 — E3, F1

MANURE CAN BE PROCESSED AND SOLD AT A PROFIT
Agricultural Extension Service, University of California, Los Angeles.
J. Van Dam, and C. A. Perry.
A Publication of the Dow Chemical Company, The Practicing Nutrionist, Vol. 3, No. 4, pp. 40 - 42.

Descriptors: *Farm wastes, *Feedlot, *cattle, market value, waste disposal.
Identifiers: *Los Angeles County, Composting, stockpiling, packing cost.

A study to determine the actual cost of removal and disposal of manure from a beef feedlot in Los Angeles County was made by the Agricultural Extension Service. Manure was prepared for marketing in three basic forms and sold under four pricing conditions. Manure processing, packaging and marketing began with the mounding of the manure in the corrals, followed by its removal to a compost stockpile. Based on the volumes of the different product forms handled in the feedlot studied, the composted unprocessed manure had the greatest market potential. However, the processed bulk product had the greatest net revenue based on net returns, product form volumes and weighted average price, less total costs. While this study was not intended to determine the market for manure, it did determine that there was a market for various product forms - all within a competitive price range, and it is probable that a feedlot operator can make a profit from the sale of manure. (Bundy - ISU).

0754 - A3, B1, D1, E1

WASTE WATERS FROM FARMS.

Department of Scientific and Industrial Research, Notes on Water Pollution No. 17, June, 1962, 4 p, 11 ref.

Descriptors: *Farm wastes, Irrigation, *Waste disposal, Biochemical oxygen demand, Nitrogen, Biological treatment, *Waste water treatment.
Identifiers: *Soakaways.

Disposal of waste waters from farms has become a major problem as farmers have turned away from bedding down animals. Methods of disposal suggested include irrigation on land, soakaways, discharge to a sewer, and biological treatment and discharge to a stream. Silage liquor, herbicides, and pesticides all create a disposal problem. Consulting the local water quality authorities is usually the best procedure before attempting to dispose of liquors capable of water pollution. (Wallin-Iowa State)

0755 - B1, D4, E2

FEED LOT WASTE IN FLORIDA,
Orange County Pollution Control Dept., Orlando Fla.; and Soil Conservation Service, Orlando, Fla.
C. W. Sheffield, and B. Beville.
In: Proceedings, Industrial Waste Conference, 25th, May 5, 6, and 7, 1970. Purdue University Engineering Extension Series No. 137, Part 2, p 914-918, 1 fig.

Descriptors: *Waste treatment, *Biological treatment, *Waste disposal, Subsurface drains, Sprinkler irrigation, Aerobic treatment, Anaerobic digestion, Dairy industry, Cattle, Biochemical oxygen demand, Turbidity, Retention, *Farm wastes, *Feed lots, Costs.
Identifiers: Grit chambers, Polishing ponds, Sand traps.

The problems associated with animal waste disposal are becoming tremendous compared to just a few years ago. An increased number of animals has created a problem of wastes from feedlots. It has been estimated that animal waste is ten times that from human waste, or approximately 55 pounds of manure per person would be one way of estimating the amount of manure from a feedlot operation. Therefore, it could be assumed that approximately two pounds per day of BOD as runoff is associated per steer or cow. Various methods of treating animal wastes from feedlot operations were reviewed and the most practical and economical means of treating the waste from dairy and beef cattle was determined. Construction and maintenance costs for a waste treatment facility for 800 dairy cows is presented. The treatment method consists of a grit chamber followed by an anaerobic pond, then an aerobic pond and a polishing pond. The effluent is discharged through a three to five acre sub-surface drain and a five acre spray irrigation system. (Dorland-Iowa State)

0756 - B1, F3

SWINE-WASTE MANAGEMENT,
Illinois Univ., Urbana. Dept. of Agricultural Engineering.
D. G. Jedele, and D. L. Day.
Paper No. 69-934, presented at the 1969 Winter Meeting of the American Society of Agricultural Engineers at Chicago, Illinois, 4 p.

Descriptors: *Farm wastes, *Legal aspects, *Design criteria, Hogs, Odor, Treatment facilities, Water pollution, Water quality, Design standards, Specifications, *Waste water treatment.
Identifiers: *Odor control, Stream pollution, Guidelines.

Producers of livestock are experiencing difficulties in the design of waste treatment facilities. These producers, motivated by a desire to avoid lawsuits or a desire to be good neighbors, are hard pressed to determine exactly how much treatment and what type of treatment is needed to prevent objectionable odors and stream and groundwater pollution. Most references and guidelines contain terms such as 'if you are not too close to your neighbors' and 'they sometimes release objectionable odors.' Producers want to know such things as how close is close and just how objectionable are the objectionable odors. Producers need to know their chances of being the object of a lawsuit or producing runoff that will result in pollution to water. Some type of guideline is needed to tell a producer what type of treatment he needs to satisfy his circumstances. (Dorland-Iowa State)

0757 — B2, C5, D4

AEROBIC TREATMENT OF SWINE WASTE
Research Associate, University of Illinois, Urbana.
R. L. Irgens, and D. L. Day.
In: Illinois Research, University of Illinois Agricultural Experiment Station, Fall 1965, pp. 14 - 15. 2 fig.

Descriptors: *Farm Wastes, Aerobic Treatment, Swine, Confinement Pens, Aeration, Biochemical Oxygen Demand, Chemical Oxygen Demand, ammonia, nitrate, phosphate, hydrogen Ion Concentration, Odor.
Identifiers: *Moorman Swine Research Farm.

A laboratory investigation was made to determine: How well can swine waste, which is more concentrated than municipal waste, be stabilized by aerobic treatment. How much must the liquid manure be diluted to obtain satisfactory results? How much air is required for the process of aerobic stabilization? Aerobic treatment of swine waste proved to be odor free and did not attract flies. Carbon dioxide was the only gas produced. The effluent had a low BOD, 12 to 20 ppm which will not pollute streams if discharged into them. Results of these experiments gave the following design requirements for an aerobic treatment plant: Volume in aeration tank or ditch — 6 cubic feet per pig; quantity of air required — 2500 cubic feet per pound of BOD at 3 percent efficiency of oxygen utilization. In the laboratory treatment system, results were more satisfactory when small amounts of manure were added daily than when large amounts were added weekly or monthly. It was thus concluded that odorless aerobic treatment could be integrated with self-cleaning slatted floors so the pig excreta would be deposited directly into the treatment plant. The manure collection gutters could be connected at the ends to make a continuous channel and an aerator would keep the solids suspended, circulate the liquid manure, and add the necessary oxygen. Facilities to field - test this method are being constructed. (Bundy-ISU).

0758 - B2, D1, E1, F3

HANDLING AND DISPOSAL OF CATTLE FEEDLOT WASTE,
Texas Tech Univ., Lubbock.
R. C. Albin.
Journal of Animal Science, Vol. 32, No. 4, April 1971. p 803-810. 2 tab, 71 ref.

Descriptors: *Farm wastes, *Feed lots, Cattle, Water pollution, Biochemical oxygen demand, *Waste disposal, *Oxidation lagoons, *Waste

water treatment.
Identifiers: Liquid handling systems, Anaerobic lagoons.

The exponential expansion of cattle feeding in the United States during the last decade has created many challenges, among which are the handling and disposal of a by-product, feedlot waste. It can be categorized as solid or semi-solid waste and runoff water for most feedlots, or as a liquid suspension from confined feeding operations. The chemical and pollutional characteristics are variable. Numerous handling and disposal systems are available for management of cattle feedlot waste. The disposal system for a commercial feedlot could be characterized as a function of several parameters, such as climate, type of ration and cattle, feedlot surface, and cattle and human population densities, with the solution stated in economic equivalents. Final disposal of feedlot waste has been on the land in most instances. The oxidation ditch and a combination of aerobic and anaerobic systems offer possibilities. Socio-industry relationships might require ultimate disposal of runoff and effluent into streams with dehydration and/or incineration of the solid waste. Use of feedlot waste as a resource material offers unlimited possibilities as a conservation approach to feedlot waste management. The need for research in feedlot waste management is urgent. Critical evaluations of handling and disposal systems for cattle feedlot waste are needed in the areas of land use, socio-legal-industry relationships, environmental pollution, conservation and economics. (Bundy-Iowa State)

0759 - A2, B1, C1

STREAM POLLUTION FROM FEEDLOT RUNOFF,
Kansas State Dept. of Health, Topeka. Environmental Health Services.
J. L. Mayes, S. M. Smith, and J. R. Miner.
Paper presented at the Fourteenth Annual Conference on Sanitary Engineering, University of Kansas, Lawrence, January 8, 1964. 24 p, 4 fig, 8 tab.

Descriptors: *Farm wastes, Feed lots, Kansas, Runoff, Biochemical oxygen demand, Chemical oxygen demand, Ammonia, Nitrogen, Fishkill, Cattle, *Agricultural runoff, *Water pollution sources, *Water pollution effects.

During the investigation of water pollution complaints and fish kills, the Kansas State Department of Health has found animal feedlot runoff to be the cause of a number of water pollution problems. The principal problems have occurred in water courses below feedlots where large numbers of farm animals, primarily cattle, are concentrated in feeding areas. Water pollution studies of streams polluted with feedlot runoff indicate that the runoff is characterized by a high biochemical oxygen demand, high ammonia content, and heavy bacterial populations. The pollution problem is intermittent since it occurs during the following runoff, but it causes a severe slugging effect on the stream. Serious depletion of the dissolved oxygen content of the stream may occur, especially if the stream is small or the waste load is large. Present knowledge does not allow a quantitative prediction of the degree of pollution that can be expected from a given feedlot operation on a given occasion. This seems to be dependent upon a variety of factors such as the size of the lot; the cleanliness of the lot when runoff occurs; general topography of the area and the location of the lot with respect to receiving waters; the amount of rainfall, its intensity and pattern within the drainage basin; the size of the receiving stream and the pollution control measures in use. (Bundy-Iowa State)

0760 - B1

HIGH TEMPERATURE ENVIRONMENT EFFECTS ON GESTATING SWINE,
Oklahoma Agricultural Experiment Station, Stillwater.
G. W. A. Mahoney, I. T. Omtvedt, D. F. Stephens, E. J. Turman, and R. Edwards.
Paper presented at Annual Meeting of the Southwest Region, American Society of Agricultural Engineers, April 3-5, 1968, Baton Rouge, Louisiana, 14 p, 3 fig, 3 tab, 3 ref.

Descriptors: *Farm wastes, Confinement pens, *Swine, Ventilation, Cooling, *Temperature, *Environmental control.
Identifiers: *Slotted floor, Farrowing, Control chamber.

The objectives were to investigate the effect of high ambient temperatures on swine prior to breeding and during gestation on the estrual cycle, conception rate and subsequent embryo survival; to attempt to determine the 'critical' periods of temperature stress prior to breeding and during gestation for subsequent testing; and to evaluate the performance of the environmental chambers constructed for this study. There was a definite tendency toward reduced corpora lutea, fewer viable embryo, lower survival rates and smaller embryos for the gilts in the heat stress chamber. The differences were significant ($p < 0.05$) for reduced viable embryo and survival rates for gilts stressed 1-15 days postbreeding. Rectal temperatures were significantly higher for gilts in the heat chamber. Also, six gilts, of the 32 in Trials 1 and 11, died due to heat prostration. The environmental chambers performed satisfactorily but needs some modification and improved instrumentation and controls. Humidity controls are needed so effects of environment with various high humidities and temperatures can be investigated. Present modifications of the heating system are currently in progress and should result in better control of high temperatures and result in more uniform temperature, rather than the present 6 degrees variation, or plus or minus 3 degrees above and below 102 degrees F. (Bundy-Iowa State)

0762 - F4

LIVESTOCK WASTE MANAGEMENT AND POLLUTION ABATEMENT.

Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, American Society of Agricultural Engineers, St. Joseph, Michigan, 1971, ASAE Publication PROC-271, 360p.

Descriptors: *Farm wastes, *Odors, Economics, Drying, *Aerobic treatment, Runoff, Cattle, Swine, Poultry, Dust, *Aerobic lagoons, Hydraulic structures, Water pollution control, Waste water treatment, Waste disposal, *Pollution abatement.
Identifiers: *Solid-liquid separation, Canada, Europe, *Anaerobic lagoons.

The proceedings of the International Symposium on Livestock Wastes includes approximately 100 papers. The topics include waste disposal systems, beef feedlot systems, legal and administrative considerations, characteristics, hydraulic transport, composting, drying, economics, aerobic treatment and storage, land disposal, refeeding, and solid-liquid separation. Contributions were received from Canada and Europe, as well as the United States. Each paper attempted to demonstrate techniques that allow the coordination of various waste treatment units into workable systems. Research of more than 200 scientists from 30 states and 9 nations was reported. Some were rather novel approaches that might be several years from acceptance and others are modifications of known technology with good prospects for more immediate acceptance.
(Bundy-Iowa State)

0763 - F3, F4

ANIMAL WASTES AND AMERICA THE BEAUTIFUL,
Department of Agriculture, Washington, D.C.
N. D. Bayley.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p. 6-7.

Descriptors: *Farm wastes, Confinement pens, Odors, Nutrients, Pathogens, Waste disposal, Economics, *Research priorites.

Along with the moving of animals from open range to confinement pens came waste management problems including odors, nutrients, and disease. All of these should be managed in such a way to make America more beautiful and a better place to live. The highest item on research priorities should be to find more and better ways to dispose of organic wastes on land. The next priority should be to control odors from wastes. Very little is known about this problem. A third priority for research should be to look at the entire technology required to deal with animal wastes. This would include starting with the feed produced for the animal to the disposal of the animal waste. Research must be able to evaluate all costs and benefits - tangible values such as outdoor recreaction and fish and wildlife enhancement, secondary benefits that are to some extent quantifiable, such as benefits to the economy - local, regional, or natural and intangible benefits we have not always considered, such as the preservation of natural beauty.
(Bundy-Iowa State)

0764 - F3

FUTURE PROSPECTS FOR ANIMALS AGRICULTURE,
Ohio State Univ. Columbia. Coll of Agrigulture and Home Economics,
R. M. Kottman, and R. E. Geyer.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p. 9-18, 18 tab.

Descriptors: *Farm wastes, Economics, Income, Agriculture, Livestock, Poultry.
Identifiers: Diet-health relationships.

The opportunity for U.S. animal agriculture to provide larger supplies of all animal products during the next 30 years offers an exciting challenge. United States animal agriculture will however, face stiff competition from other food sources, but such competition will assist the U.S. animal agriculture by forcing it to remain progressive. To remain competitive, United States livestock and poultry producers, as well as processors of animal products are challenged to: (1) produce continually higher quality products on the farm with greater eficiency; (2) develop and implement dramatic new methods to control pollution and to utilize waste resources; (3) develop new, low-cost, convenient and tasty foods from animal sources; (4) encourage expansion of research designed to eliminate current unknowns regarding diet-health relationships; (5) DEVELOP AND IMPLEMENT NEW AND GREATLY EXPANDED PROGRAMS TO EDUCATE CONSUMERS AS TO THE HEALTH AND NUTRITIONAL PROPERTIES OF ANIMAL FOODS; (6) substantially increase industry-wide consumer marketing programs, especially zeroing in on the markets for protein, calcium, iron and other animal-derived nutrients essential to human growth and health. (Bundy-Iowa State)

0765 - F3

ROLE OF STATE DEPARTMENTS OF AGRICULTURE IN PROBLEMS OF ANIMAL WASTE MANAGEMENT,
National Association of State Departments of

Agriculture, Washington, D.C.
S. Cath.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971. p. 21-22.

Descriptors: *Farm wastes, *Federal Governments, *State Governments, *Local Governments, Regulation, Control, Research priorities, Waste disposal.

State Departments of Health, Agriculture, and Environmental Protection, and Livestock Sanitary Commissions are some of the agencies that put regulations and control on cattle, hog, sheep, and poultry operations. The National Association of State Departments of Agriculture, at their 1969 convention, in resolution form, urged that the Secretary of Agriculture and the land-grant universities give a higher priority to waste disposal and requested the Congress to provide additional funds to carry out the necessary research. Also, the State and Local Governments must develop methods to prevent farm-urban confrontation on the waste and pollution problem. In the practical sense however, good regulatory enforcement of livestock waste disposal can only proceed as fast as the results of good research. Regulatory enforcement should never exceed the state of the art. Livestock industries should not have to cope with unfair regulatory demands that cannot be met.
(Bundy-Iowa State)

0766 - F4

RESPONSIBILITIES OF A PROFESSIONAL SOCIETY TOWARD URGENT SOCIAL PROBLEMS,
Texas A and M Univ. College Station. Dept. of Agricultural Engineering.
R. E. Stewart.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p. 23-24.

Descriptors: *Technology, Engineering, Air pollution, *Social needs, Environment, Urbanization.
Identifiers: *American Society of Agricultural Engineers, *Professional societies.

Today is an age of growing doubt and mistrust of technology. Many of the benefits technology has brought to the West (and they are many) are being downgraded by the increasing concern over pollution, ugly environment, exploited resources, and disregard of human values. The engineer is increasingly cast in the role of a mindless villain for whom efficiency is measured only by dollar profits and losses. The dilemma, as it appears to be posed for the American Society of Agricultural Engineers (ASAE) and the community of agricultural engineers, is examined from the two viewpoints of urbanization and environmental quality; both of these factors represent urgent contemporary social problems. ASAE could help to reduce the urban crisis by turning massive attention to rural development, including redeployment of industry into the countryside. ASAE could help to solve the environmental problems by increased zeal in working with the public on chemical pesticides, wastes recycling, soil erosion, and wiser exploitation of natural resources. Such effort must be supported by the will of the people, as expressed through the public budgets. The benefits of such work should be at least equal to those derived from the mighty efforts applied to outer space. Moreover, this can be done without sacrifice of any capacity for food production.
(Bundy-Iowa State)

0767 - B1, F3

PUTTING IT ALL TOGETHER,
N. H. Curry.
In: Livestock Waste Managmement and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p. 25-26.

Descriptors: *Federal government, State governments, Budgeting, Design, Engineering, *Research and Development, *Planning, *Projects, *Project planning, Facilities, Bids.
Identifiers: Contractors.

The normal steps in the development process - from project conception to new facilities operation - for institutionally or corporately-owned research and demonstration installations, as well as privatley or corporately-owned waste treatment and handling units used in production operations. Some predictable problems and pitfalls are discussed. Due to the long process of development, many changes may be anticipated as the project plans develop. These include: (1) a general upgrading of the proposed quality of construction and the incorporation of more sophisticated equipment; (2) a better relation of the project facility design with the statistical design and operational procedures of the proposed experiments, or an improved solution to practical problems in a production facility (the time delay is not all bad); (3) changes in research, administrative, and elective official personnel; (4) project expansion or development of interdisciplinary programs; (5) continued construction cost inflation; (6) competition for funds with other projects; (7) a tendency of administrators in dealing with state legislatures or congress to 'horse trade', or drop smaller projects in order to assure obtaining the 'big ones.' This is not necessarily bad from an overall standpoint - few administrators are promoted for thinking small - but this is faint consolation to the individual or group badly in need of a new facility.
(Bundy-Iowa State)

0768 - D2

SYSTEMS FOR THE DEHYDRATION OF LIVESTOCK WASTES: A TECHNICAL AND ECONOMICAL REVIEW,
H. G. Scholz.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971. p. 27-29, 5 fig, 2 tab.

Descriptors: *Farm wastes, *Biological treatment, Aerobic treatment, Anaerobic digestion, Swine, *Dehydration, Drying, Liquid wastes, Poultry, Wastes water treatment, Economics.
Identifiers: *Humus manure.

Both biological decomposition and incineration result into a final product which is not marketable. On the other hand, dehydration followed by pulverization of livestock wastes offers the possibility of a product which can be bagged and sold as soil amendment. It is even possible, under European conditions, to have the returns from such a system redeem the capital and operating cost of the plant. Such a system has been designed and is in operation in Europe. In this system, wastes are homogenized and then conveyed to a rotary drum drier. Moisture is removed, and the dried material is conveyed to a cyclone and baged. Flue gas is scrubbed by pumping fresh liquid manure from the building into a venturi scrubber. Manure, heated through contact with the flue gas, falls, into a storage tank which is also used to aid in reducing the moisture content of the manure. The contents of the tank are mixed thoroughly to increase the evaporation surface area of the liquid. This mixing also helps homogenize the manure before it is pumped into the rotary drum. Wastes from poultry, dairy cattle and swine need be treated differently before the drying takes place. Different designs incorporating such pretreatments are described and illustrated with photos.
(Bundy-Iowa State)

0769 - B1, E2

A COMPUTER MODEL FOR STORAGE AND LAND DISPOSAL OF ANIMAL WASTES,
Florida Dept. of Agricultural Engineering. Univ., Gainesville.
R. A. Nordstedt, H. J. Barre, and E. P. Taiganides.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971. p. 30-33, 6 fig, 4 ref.

Descriptors: *Farm wastes, Computer models, Mathematical model, Waste storage, *Waste disposal, Optimization, Nutrients, Model studies, *Scheduling.
Identifiers: *Manure spreading, Tank wagon, Fortran IV Language.

A model was developed for optimizing and studing long-term scheduling decisions for removing livestock wastes from storage and spreading them on agricultural lands. The storage and land disposal system was modeled as a multistage decision process. Dynamic programming techniques were used to find the optimal disposal schedules (time and quantities). The maximum quantity which can be disposed in each time period is constrained by storage capacity, quantity of waste generated and land area available for spreading the wastes. An important feature of this model is that most parameters are permitted to be functions of time. Transport vehicle capacity, operation times, and cost of labor are not as significant as fixed storage cost, but they were sufficiently important to merit consideration in the design and operation of the system. Land availability and nutrient effectiveness (as compared to inorganic fertilizers) as a function of time were also significant. The model is sufficiently flexible for use as a decision tool in the design of operational systems as well as for use as a simulation tool in studying storage and land disposal systems. (Bundy-Iowa State)

0770 - B1

LIVESTOCK WASTE MANAGEMENT AND THE CONSERVATION PLAN,
Soil Conservation Service, Washington, D. C. Engineerineering Div.
C. E. Fogg.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971. p. 34-35, 2 tab, 8 ref.

Descriptors: *Farm wastes, Aerobic lagoons, Liquid wastes, Federal Governments, Local Governments, State Governments, Groundwater, Runoff, Biochemical oxygen demand, Irrigation systems, *Waste disposal, Waste water treatment.
Identifiers: Anaerobic lagoons, Health agencies.

Waste management systems must provide for utilization or disposal of livestock wastes without pollution or surface or ground waters and without objectionable odors. A sound system should (1) divert clean water away from areas where livestock wastes are concentrated, (2) provide controlled drainage of runoff from such areas, (3) PREVENT LEACHING OF CONTAMINANTS INTO GROUND WATER, (4) collect polluted runoff; and (5) treat or safely dispose of collected runoff. Solid manure should be removed and stockpiled until it can be safely spread on the land or deposited in the land. Liquid manure resulting from many dairy, swine and poultry operations as well as polluted runoff from concentrated livestock areas can often be disposed of by a water spreading or irrigation system utilizing the soil and plant cover for treatment. Nutrients in such wastes are used by the plants or tied up in the soil provided amounts applied are kept within recommended limits. Aerobic and anaerobic lagoons used singularly or in combination often provide at least partial treatment of liquid manure wastes.

They are usually supplemented by application of the effluent to the land by land spreading or irrigation. (Bundy-Iowa State)

0771 - B1, F4

TECHNOLOGICAL AND TECHNICAL CONCEPTIONS OF MANURE HANDLING IN CZECHOSLOVAKIA,

Vyzkumny Ustav Zemedelske Techniky, Repy (Czechoslovakia).
M. Velebil.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p. 36-38, 4 fig., 2 tab., 1 chart.

Descriptors: *Farm wastes, Cattle, Litter, *Waste disposal, Cleaning, Hogs, Economics.
Identifiers: *Czechoslovakia, Barn cleaning, Slatted floor.

The technology and techniques of handling swine and dairy manure are discussed. Results of laboratory and field research and experimentation, theoretical analyses and conceptions, and economical evaluations are included. Manure removal from the stables and its application on the field are described. (Bundy-Iowa State)

0772 - B2

A LAND RECYCLING LIQUID MANURE SYSTEM FOR A LARGE-SCALE CONFINEMENT OPERATION IN A COLD CLIMATE,

Department of Agriculture, Ottawa (Ontario). Engineering Research Service.
J. E. Turnbull, F. R. Hore, and M. Feldman.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p. 39-43, 2 fig., 6 tab., 4 ref.

Descriptors: *Farm wastes, Water pollution, Confinement pens, Odor, Cattle, Liquid waste, Air pollution, Water reuse.
Identifiers: Sluice-gate recirculation system, Plow-cover injector system.

A full-scale liquid manure system is described for the confined housing of approximately 800 dairy cattle, 1,300 sheep, and 40,000 poultry situated on a 2,800 acre animal research site adjacent to suburban housing near the city of Ottawa. The system is based on the established practice of recycling animal wastes to cropland. Through design, planning and management, the system comes very close to meeting presently accepted criteria for the control of water, air and soil pollution. The system contains a total of six-months storage capacity to avoid the potential for water pollution from winter land application of manure. Waste removal from trench storage in cattle and sheep barns is assured by use of the European hydraulic flushing system, and conventional scraping is used for poultry. Manure is held in storage under quiescent, low odor conditions. When manure is agitated for removal from storage, some odor is produced at the building site and a nuisance potential is created. However, site planning makes this potential problem practically non-existent since adequate space separation between the barns and surrounding neighbors was provided. Enclosed tankers control odors during transport and by applying the principle of rapid soil cover of manure, a relatively odor-free method of land disposal is achieved. The development of an inexpensive hooded tanker outlet which directs manure downward in a four-foot wide swath allows a tractor and plow to straddle and cover the manure in several seconds. Manure application rates do not exceed presently accepted levels for soil pollution control. (Bundy-Iowa State)

0773 - A2, C2, C3, C4, C5

MEASUREMENT OF RUNOFF AND RUNOFF CARRIED WASTE FROM COMMERCIAL FEEDLOTS,

South Dakota State Univ., Brookings. Dept. of Agricultural Engineering.
J. M. Madden, and J. N. Dornbush.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p. 44-47, 2 fig., 6 tab., 4 ref.

Descriptors: *Farm wastes, Feed lots, Runoff, Biochemical oxygen demand, Chemical oxygen demand, Phosphate, Cattle, *South Dakota, Path of pollutants.

The objectives were to (1) determine the quantity and quality of runoff from livestock feeding operations in South Dakota, (2) to relate the above information to hydrological and geological considerations in order to appraise the overall influence of this runoff on specific beneficial uses of receiving water, (3) determine the influence of spring runoff as it occurs in northern climates, and (4) determine the pollutional characteristics attributable to the suspended matter in the feedlot runoff in order to extrapolate the effectiveness of proposed lagooning methods of treatment. Measurements have been made on four commercial sized feedlots for two years and an additional two lots for one year. Runoff has been quantified and composite and grab samples have been analyzed to determine the BOD, COD, dissolved and suspended solids, nitrogen forms, and phosphate content. The results have been used in the development of feedlot regulations and engineering standards for the control of feedlot runoff. Suggestions are also being made as to the type of treatment and management practice which will reduce the pollution potential. (Bundy-Iowa State)

0774 - A2, B2, C1

MANAGEMENT OF BARNLOT RUNOFF TO IMPROVE DOWNSTREAM WATER QUALITY,

Ohio Agricultural Research and Development Center. Wooster.
W. M. Edwards, F. W. Chichester, and L. L. Harrold.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p. 48-50, 5 fig., 8 ref.

Descriptors: *Farm wastes, Sprinkler irrigation, Runoff, Chemical analyses, Biochemical oxygen demand, Nitrogen, Phosphorus, Water quality.
Identifiers: *Biological analyses.

Quality of runoff from a small sloping barnlot is related to that of the larger farmland watershed of which the barnlot is a 0.005 part. Livestock waste was allowed to enter the stream system for a two year period, during which time the rate, volume, and quality of runoff was measured at the barnlot and downstream site. During the third year, barnlot runoff was diverted into a temporary storage pit and subsequently distributed through a sprinkler system onto nearby pasture land. Under these conditons no effluent from the barnlot was allowed to enter the stream system. Continued hydrologic and quality evaluations defined the effect of the barnlot runoff disposal system on downstream water quality. Chemical and biological analyses of runoff samples were made to relate water quality to hydrologic performance. BOD values for barnlot samples ranged from 10 to 420 mg/l as compared to <1 to 40 mg/l for stream samples taken at the watershed outlet. Concentrations of nutrients (mg/l) in the liquid phase of the barnlot runoff ranged from 10 to 70 total N, <1 to 15 NO3 (-)-N, <1 to 30 NH4 (+)-N, 5 to 60 organic N, and 1 to 10 P. Concentrations associated with the 0.1 to 1.5% w/v solid material separated from the runoff samples were <1 to 150 ppm NO3 (-)-N, 100 to 2,000 ppm NH4 (+)-N, 10,000 to 40,000 ppm organic N, and 300 to 1,200 ppm P. (Bundy-Iowa State)

0775 - A2, B1, C3

TRANSPORT OF POLLUTANTS FROM SLOPING CATTLE FEEDLOTS AS AFFECTED BY RAINFALL INTENSITY, DURATION, AND RECURRANCE.

Agricultural Research Service, Lincoln, Nebr. Soil and Water Conservation Research Div.
N. P. Swanson. L. N. Mielke, J. C. Lorimor, T. M. McCalla, and J. R. Ellis.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p. 51-55, 4 fig., 4 tab., 9 ref.

Descriptors: *Farm wastes, Feed lots, Runoff, Cattle, Microorganisms, Rainfall, Nitrogen, Phosphorus, E. Coli, Bacteria, Fungi, Coliform, Crops, Path of pollutants, *Central U.S.
Identifiers: Rainfall simulator.

The pollution of surface waters by cattle feedlot runoff is of serious concern in the midwestern United States. Pollutants are transported in solution, in suspension, and as bedloads by feedlot runoff. The pollutants may be chemicals, microorganisms, organic materials, and soil sediments. Research on a feedlot instrumented for continuing runoff measurement and sampling, and research using a rainfall simulator on runoff plots on 8- and 13-percent slopes in another feedlot indicate that the pollution potential is not a direct function of only the yield of runoff. In one experiment on an 8-percent slope, a simulated rain of 2.8 inches per hour provided runoff with initial rates of loss per acre per hour of 4680 lbs. of total solids, 1160 lbs. volatile solids, 11.6 lbs. phosphorus, and 66.9 lbs. of organic nitrogen. Both the chemical contents of runoff (conductivity, total N, NH4N, NO3N, and COD) and the volume of solids decreased with continuing runoff. Runoff samples contained appreciable numbers of E. coli, Enterococci, total bacteria, fungi, bacilli, and clostridium. Higher intensities of rainfall provide added energy for increased detachment and transport of solids which adds to the pollution potential of each unit of runoff. The chemical content of feedlot runoff is compared with analyses of runoff from cropland recently published by other researchers in the midwestern United States. (Bundy-Iowa State)

0776 — B1, C1, C5

CHARACTERISTICS OF MANURE ACCUMULATIONS REMOVED FROM OUTDOOR, UNPAVED, BEEF CATTLE FEEDLOTS.

Agricultural Engineer, Lincoln, Nebraska.
C. B. Gilbertson, T. M. McCalla, J. R. Ellis, and W. R. Woods.
Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19 - 22, 1971, p. 56 - 59, 6 fig., 4 tab., 8 ref,

Descriptors: *Farm wastes, Cattle, Feedlots, Biochemical oxygen demand, Chemical oxygen demand, Nitrogen.
Identifiers: *Nebraska Field Laboratory, Unpaved feedlots.

Manure management is a necessary practice for beef feedlot operators unless area provided per animal is great enough to eliminate significant manure buildup on the feedlot surface. A study was initiated in 1968 to determine the effect of surface slope and cattle density on the quantity and quality of manure accumulation on outdoor beef feedlots. New feedlots with 3, 6, and 9% slopes were completed in July, 1968. Cattle were placed in each pair of lots at densities of 100 and 200 sq. ft. per head. Results have shown that considerable soil was mixed with accumulated manure by normal cattle movement within the lot. Dry matter removed from the lots averaged 2.3 times more for cattle densities of 100 sq. ft. per head than for lots with cattle densities of 200 sq. ft. per head. Feedlot slope appeared to have little effect on the amount of material removed. Approximately 30% of the total solids removed was volatile. BOD and COD values were highly variable. Further, each ton of dry matter removed contained 24 to 34 pounds of N, (Bundy-Iowa State).

0777 - A1, B3, D1, E1

FEEDLOT MANURE MANAGEMENT IN A DESERT CLIMATE,
California Univ., Davis. Dept. of Agricultural Engineering.
S. R. Morrison, G. P. Lofgreen, and T. E. Bond.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p. 60-61, 2 fig., 2 tab., 8 ref.

Descriptors: *Farm wastes, Odor, Dust, Nitrogen, Lagoon, Sludge disposal, Evaporation, Aerated lagoons, Sprinkler irrigation.
Identifiers: *Anaerobic lagoon, Imperial Valley (Calif).

Manure management problems are somewhat different in desert climates from those in regions with higher rainfall, and in some respects are less severe since runoff is not likely to cause stream pollution. More usual problems are impairment of human environment due to dust, odors, and flies; manure disposal without available cropland; and cattle performance impaired by muddy lots in winter and heat and dust in summer. To overcome these problems in the Imperial Valley of California a system using slatted floors, anaerobic pits, aeration lagoons, and a sludge disposal area is under investigation. Initial tests were done to determine the effect of loading rate on decomposition of organic matter and nitrogen, and the surface area required for evaporation of liquid wastes. Two 210-day tests have been completed using standard feedlot practices and animals on a 90 percent concentrate ration. Reduction of organic matter generally increased with decreasing loading rate, with about 70 per cent being lost at 0.023 lb/day/ft3. About 50 per cent of the nitrogen was removed at this loading rate. A surface area of 50 sq. ft. per animal was sufficient to evaporate the water from the waste. The cattle performed satisfactorily on the slatted floors, which had also functioned well in tests of a sprinkling system for heat-stress relief. (Bundy-Iowa State)

0778 - C1, E2

LAND DISPOSAL OF CATTLE FEEDLOT WASTES,
Kansas State Univ., Manhattan. Dept. of Agricultural Engineering.
H. L. Manges, L. A. Schmid, and L. S. Murphy.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p. 62-65, 4 fig., 1 tab., 4 ref.

Descriptors: *Farm wastes, Cattle, Feed lots, Runoff, Lagoon, Rainfall, Nitrogen, Phosphorus, Corn, Irrigation, Chemical oxygen demand, Crop response.
Identifiers: *Pratt Feed lot.

The objectives are 1) to characterize stormwater runoff from a feedlot, 2) to characterize manure generated in a feedlot, and 3) to determine the influence of different lagoon water and manure loadings on the soil, stormwater runoff from the disposal area, and corn yields. Analyses of runoff from rainfall have shown a COD of 4,000 to 10,000 mg/1, nitrogen of 100 to 800 ppm., phosphorus of 40 to 500 ppm. and total salts of 5,000 to 6,000 ppm. Analyses are being made to determine the concentration of other cations. Runoff from snowmelt has had a pollution load several times that from rainfall. During 1970, corn was grown on plots which received 0, 2, 4, 8, and 16 inches of lagoon water. Each plot was replicated 4 times and irrigated with well water as needed. Forage corn yields were measured. During 1970, corn also was grown on plots on which manure was plowed down at rates of 0, 10, 20, 40, 80, 160, and 320 tons per acre. Each plot was replicated four times and irrigated with well water. The manure was relatively high in nitrogen, calcium, iron and potassium with lesser amounts of magnesium, phosphorus, sodium and zinc. Plant population decreased as rate of manure application increased. Forage yields increased as rate of manure application increased up to 80 tons per acre. Above 80 tons manure per acre, corn yields were depressed.
(Bundy-Iowa State)

0779 - B2, E1

EVALUATION OF BEEF FEEDLOT WASTE MANAGEMENT ALTERNATIVES,
Oklahoma State Univ., Dept. of Agricultural Engineering. Stillwater.
A. F. Butchbaker, J. E. Garton, G. W. A. Mahoney, and M. D.. Paine.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22 1971, p. 66-69, 6 fig., 2 tab., 6 ref.

Descriptors: *Farm wastes, *Pacific Northwest U.S., Waste treatment, Waste disposal, Cattle, *Feed lots, Confinement pens, Runoff, Design, Costs, *Design criteria, Southwest U.S., Central U.S., Computer programs.
Identifiers: Southern High Plains, Liquid flush system, Slotted floor.

The objectives were: (1) to develop beef feedlot design criteria to minimize pollution from runoff-carried wastes and to facilitate handling of solid and liquid animal wastes, and (2) to examine alternative beef feedlot waste disposal systems to obtain minimum cost systems for effective waste disposal. Waste handling systems for beef feeding operations were observed in the upper Midwest, Southern High Plains, desert Southwest, and Pacific Northwest. The systems studied included: slurry, solid, and runoff-carried waste handling systems. The ultimate disposal of the waste material was considered for each system. The design criteria developed represents the state of the art for most design considerations for confinement feeding facilities and open feedlot facilities. The results are presented in terms of flow diagrams and graphs comparing the various systems.
(Bundy-Iowa State)

0780 - B1, C5

THE WASTE PATTERN OF BEEF CATTLE ON SLATTED FLOORS,
Agricultural Research Service, St. Paul, Minn. Livestock Engineering and Farm Structures Research Branch.
R. O. Hegg, and R. E. Larson.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971 p. 70-72, 2 fig., 4 tab.. 8 ref.

Descriptors: *Farm wastes, Cattle, Confinement pens, Oxidation lagoons, Water pollution, Aerated lagoons, Path of pollutants.
Identifiers: *Slatted floors, High energy ration.

The distribution of wastes from beef cattle on a slatted floor with respect to the location of the feeding area and the watering area was determined. Seven trials were run to determine the waste pattern on a slatted floor over an oxidation ditch at the University of Minnesota Experiment Station at Rosemount, Minnesota. The first four trials (I-IV) were run with the self-feeder and waterer along the same side of the slatted floor area. Trials (V-VII) were run with a waterer against the wall opposite the self-feeder. Trials I through IV show that approximately 60% of the urine and 60% of the fecal matter were collected on the half of the floor that was nearest the feeder and the waterer. Moving the waterer to the opposite wall for trials V-VII changed the urine pattern such that 62% of the liquid was collected on that half of the floor nearest the new location of the waterer. The fecal pattern also changed but not to the extent that the urine pattern changed. The average daily collection of total dry solids ranged from 3.1 to 5.2 lbs/animal. The average total liquid collected each day ranged from 1.3 gallons to over 4 gallons/animal. The trials indicate that placing the waterers and feeders in one area of the confinement unit tends to concentrate the wastes in that area. (Bundy-Iowa State)

0781 - B1, D1

ANALYSIS OF DUCK FARM WASTE TREATMENT SYSTEMS,
D. D. Schulte, and R. C. Loehr.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971. p. 73-76, 9 fig., 8 ref.

Descriptors: *Farm wastes, Model studies, Aerated lagoons, Phosphorus, Biochemical oxygen demand, Water consumption, Waste treatment, Ducks (Domestic), *Dynamic programming, Mathematical models.

In order to establish a rational basis upon which alternative duck farm waste water treatment systems could be evaluated, a mathematical model was developed. This model provided a structure in which the effect of the following items on the total annual cost of wastewater treatment could be considered: (a) capital costs of land and equipment; (b) interest and amortization rates; (c) operating costs of equipment and chemical costs; (d) treatment requirements for BOD, phosphorus, and suspended solids; (e) treatment system design; and (f) operational decisions such as water use rate and duck population. The efficiencies of three treatment alternatives, (plain sedimentation, chemical precipitation, and aerated lagoons), were established through bench scale tests and from mathematical equations and published information. Application of this model to a particular duck farm demonstrated the feasibility of using analytical models for agricultural waste management. Information available from this kind of approach provides a sounder basis for decision making. The results of this project, which was completed in June of 1970, will be used as an example of how mathematical models can be applied to problems of agricultural waste management.
(Bundy-Iowa State)

0782 - A4, D4

MULTISTAGE LAGOON SYSTEMS FOR TREATMENT OF DAIRY FARM WASTE,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
R. A. Nordstedt, L. B. Baldwin, and C. C. Hortenstine.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p. 77-80, 7 tab., 8 ref.

Descriptors: *Farm wastes, *Sprinkler irrigation, Lagoons, Cattle, Biochemical oxygen demand, Groundwater, Water pollution, Aerobic lagoons, Nitrogen.
Identifiers: *Dairy, Multistage lagoons, Anaerobic lagoons.

The objectives are to (1) determine the design and operational parameters for treatment of dairy farm waste by multistage lagoon systems in areas with warm climates, sandy soils and high water tables, (2) determine the groundwater pollution potential from this type of system and any necessary corrective measures, and (3) determine the effects of the effluent from this type of system on a seepage irrigated pasture. A multistage lagoon system has been designed and constructed on a 600-cow dairy farm. The system consists of one anaerobic and two aerobic lagoons in a series arrangement. The effluent from the third lagoon flows by gravity into a 40-acre seepage irrigation system in permanent pasture. Influent and effluent of each lagoon is sampled in two week intervals. Test wells are located at 15, 50 and 100 foot intervals from the anaerobic lagoon and at 15 and 100 foot intervals from the second lagoon. Water is drawn from 30 sampling tubes in the seepage irrigated pasture at three week intervals. Results from the first five months of operation indicate an average influent BOD of 543 mg/l. at a flow of approximately 60,000 gallons per day. BOD reductions of 89%, 54% and 8% in the first, second and third lagoons, respectively, have been achieved for a total reduction of 95%. (Bundy-Iowa State)

0783 - A5, A6, D2, F1

SOLVING THE POULTRY MANURE PROBLEM ECONOMICALLY THROUGH DEHYDRATION,
Pennsylvania State Univ., University Park. Dept. of Poultry Science.
G. O. Bressler, and E. L. Bergman.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p. 81-84, 3 fig., 5 tab.

Descriptors: *Farm wastes, Anaerobic conditons, Odor, Drying, Poultry, Bacteria, Economics, Dehydration, Air pollution, Water pollution.
Identifiers: *Heater dryer, High velocity air, Time clock, Two-stage system.

Poultry manure handling is a two-pronged problem, high moisture content and anaerobic bacterial activity causing obnoxious odors. The objectives were 1) to remove as much moisture as possible from the poultry manure inside the poultry house to lessen the weight of the material to be handled; 2) to eliminate odors and flies; and, 3) to develop an automatic system of manure handling to eliminate manual labor. A two-stage drying system achieving these objectives has been developed. Stage 1 drying occurs inside the poultry house by application of high velocity air to the manure and stirring the manure frequently. In this stage manure is dried to about 30% moisture, which is 1/3 of the original weight and it is relatively free of obnoxious odors because odor producing bacteria are destroyed. Movement of air at high velocity (500 feet per minute) is accomplished by operating continuously 20-inch fans spaced about 35 to 40 feet apart lengthwise to the manure bays or pits inside the poultry house. Stirring is accomplished with a specially designed rake and cleaning device which turns, churns, tumbles, and mixes the poultry droppings as they fall to the floor underneath the birds. The dry, powdery product is free of obnoxious odors, has shelf life, and is in a form acceptable for merchandising as an organic fertilizer. Income now being received for this product exceeds the costs of Stage 1 and 2 drying methods. (Bundy-Iowa State)

0784 - B1

A FARM SCALE DAIRY WASTE DISPOSAL SYSTEM,
Washington State Univ., Pullman.
D. O. Turner, and D. E. Proctor.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p. 85-88, 4 fig., 4 tab., 6 ref.

Descriptors: *Farm wastes, Cattle, Sprinkler irrigation, Confinement pens, Lagoons, Nitrogen, Rotations, Waste disposal, Waste storage, Crop response, Washington.
Identifiers: *Large annual rainfall, Plastic irrigation pipe.

Livestock wastes from beef feed lots and from the dairy cattle industry are produced in large quantities in small areas. A systems approach to waste disposal has been developed by Washington State University in conjunction with the Washington State Department of Institutions' Honor Farm at Monroe. This system uses a covered confinement area to exclude excessive rainfall; a collection and transfer system to move wastes from confinement areas to storage lagoons; and pipeline and sprinkler systems to move wastes from confinement areas or lagoons to areas of ultimate disposal by field application. Animal waste from a herd of 250 mature Holsteins is scraped, flushed, and transported with minimum water into two 1,000,000 gallon capacity lagoons where it is held in winter storage for field distribution during the growing season. The organic degradation and nutrient recycling capability of soil as a receiver of wastes, coupled with seasonal application, appears to be the key to such waste disposal. Loading levels are being defined under field conditions. Crops under study are silage corn, cereal rye for greenchop, and grass legume pastures, as these crops complement dairy operations and tend to recycle nitrogen. Measurements are being taken of distribution patterns by the sprinklers, infiltration rates, bacteria survival, nitrate-nitrogen concentrations in the forage and through the soil profile to a 4-foot depth, BOD counts, botanical composition of forage stands, and crop yields.
(Bundy-Iowa State)

0785 - E3

A TOTAL BIOCHEMICAL RECYCLE PROCESS FOR CATTLE WASTES,
Babson Bros. Co., Elmhurst, Ill. Environmental Div.
L. G. Carlson.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 89-91. 3 fig, 5 ref.

Descriptors: *Farm wastes, Cattle, Liquid wastes, Phosphates. Proteins, Biochemical oxygen demand, Chemical oxygen demand, Nitrogen, Potassium, Microorganisms.
Identifiers: *Babson Biochemical Process, Reaction tower.

The Babson Biochemical Process accepts cattle wastes, such as liquid manure, and recovers undigested solids, as washed and cleaned particulate matter, from a counter-current classification tower. The solids are pelletized into slugs two inches in diameter and one-half inch thick. The remaining liquid, consisting of suspended solids, dissolved solids, and some colloidal matter, is pumped to a Reaction Tower, Reaction Vessel, and Enzyme Vessel complex, wherein, bubbles are formed as a function of the rate of mass transfer, and is key to this biochemical process. The residence time is a few hours with partial recycle to keep enzymatic activity high. Recovery of activity is very rapid, even after several weeks in the endogeneous phase. The effluent is then sent to a flocculation/coagulation (F/C) system, where phosphates, proteins, polysaccharides, metal ions, etc. are removed, dried, and fortified to make a fertilizer which is slow to dissolve. The liquid effluent from the F/C vessels is then deionized and decolorized, and used for drinking water, or partially de-ionized, and used for corral flushing of manure into a common pit.
(Bundy-Iowa State)

0786 - F3

THE UK RECONCILIATION OF MODERN INTENSIVE LIVESTOCK FARMING WITH A BASICALLY URBAN SOCIETY,
Agricultural Development and Advisory Service, London (England).
K. B. C. Jones.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 92-94. 5 tab, 6 ref.

Descriptors: *Farm wastes, *Animal populations, Confinement pens, Poultry, Cattle, Biochemical oxygen demand, Solid wastes, Phosphates, Nitrogen, Water pollution, Regulations.
Identifiers: Council on Environmental Quality, United Kingdom.

Intensive livestock production will continue to be centered on those parts of the UK where the soils and climate are most favorable and where workers have the technical skills, and management the financial and marketing abilities to succeed. It is most likely that as now, these units will be in lowland areas near big centers of population. Wherever possible, correlation will be maintained between size of livestock unit kept and area available for manure spreading. In time, the law may make this concept on obligation. Planning permission for non-agricultural development may be refused if it is too near an existing livestock unit. Zoning may be more widespread. New developments already require the interests of vets, neighbors, planning authority, river authority and public health inspector to be met. These interests are achieving a better understanding of the farmer:s needs and of each other:s points of view. (Bundy-Iowa States)

0787 - A1, C5, F4

IDENTIFICATION OF CARBONYL COMPOUNDS IN A SWINE-BUILDING ATMOSPHERE,
Iowa State Univ., Ames.
L. D. Hartung, E. G. Hammond, and J. R. Miner.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 105-106. 1 tab, 10 ref.

Descriptors: *Farm wastes, Atmosphere, Odor, Swine, Organic compounds, Air pollution, Land management.
Identifiers: Carbonyl-free air, Sutton's equation, *Carbonyls.

Prior studies of swine-building atmospheres have identified amines, carbonyls and sulfur compounds in these gases. More detailed identification work is being done to determine which compounds of these three classes are responsible for odor. This information should be valuable for eventual odor-control technology. Carbonyls can be determined readily as the 2,4-dinitrophenyl-hydrazine (2,4-DNPH) derivatives. A measured quantity of swine-house gas was pulled through a reaction column composed of a solution of 2,4-DNPH (in 2.5M H_2SO_4) on celite. The 2,4-DNPH derivatives were eluted from the column with hexane at the end of the run. Tentative identification was by thin layer chromatography (tlc), which allowed quantitative measurement of those compounds present in largest concentrations. In these cases, the derivative was leached from the tlc material, diluted to a measured volume, and the ultraviolet absorption max was measured. Carbonyls identified to date and their concentrations when measurable are: acetone (125 ppb by volume), ethanal, butanal, methyl ethyl ketone (53 ppb), pentanal, nonanal. (Bundy- Iowa State)

0788 - A2, A5, B1, F2

IMPACT OF FARM ANIMAL PRODUCTION

AND PROCESSING ON THE TOTAL ENVIRONMENT,
Ohio State Univ., Columbus. Dept. of Agricultural Engineering.
E. P. Taiganides, and R. L. Stroshine.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 95-98. 1 fig, 7 tab, 13 ref.

Descriptors: *Farm wastes, Biochemical oxygen demand, Chemical oxygen demand, Odor, Waste water (Pollution), *Environmental effects.
Identifiers: *Animal waste impact, Odor nuisance, Soil oxygen demand.

A long-term study under the auspices of the Agricultural Pollution Control Research Laboratory at Ohio State University will attempt to delineate the full impact of the world farm animal industry, from birth to the point of consumption, ultimate use, or death by decay, on the quality of the natural environment. The impact from the production of animals on USA farms was determined by using animal population figures from the 1969 U.S. Agricultural Statistics. Depending on the geographic region, various assumptions were made as to the amounts of manure which could reasonably be expected to be discharged into natural water bodies or disposed on land or into air resources. Assumptions on percentage of animals in total confinement, pasture or partial confinement were made to facilitate estimates of water runoff and land disposal. Odor nuisance could only be evaluated in qualitative terms by making assumptions on the extent of urbanization at each of the six geographic regions. A quantitative value for the impact of by-products and wastes from animal industries on the natural environment was obtained using BOD, COD, fertility nutrients, volatile solids, SOD (Soil Oxygen Demand) and physical quantities. An attempt was made to compare these values with values from other basic industries, such as car manufacturing and some chemical industries. (Bundy- Iowa State)

0789 - F3
LITIGATION EXPERIENCES OF FIVE LIVESTOCK AND POULTRY PRODUCERS,
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
T. L. Willrich, and J. R. Miner.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 99-101. 7 ref.

Descriptors: *Farm wastes, Odor, *Legal aspects, Water pollution, Swine, Cattle, Poultry, Missouri, Iowa, Judicial decisions.
Identifiers: *Law suits, Odor nuisance.

Several livestock and poultry producers have faced law suits from neighboring residents based upon complaints of odor and water pollution. Such public and private nuisance suits demand that producers consider the possible effects of their site selection and waste management practices upon neighbors. Cases concerning three beef producers, two swine producers and a poultry growing operation are considered in detail. The physical features of the systems are described, as well as the operation of the facilities. Both swine producers were utilizing confinement facilities with manure storage facilities beneath partially-slotted floors. In the Missouri case, both localized water pollution and odors were found to have caused damages to two nearby rural neighbors. Substantial punitive damages were awarded. The case in Iowa involved odors and their influence on neighbors located approximately 300 feet north of the operation. The first hearing of the case resulted in a hung jury. The poultry operation was in north-central Iowa, about 900 feet east-southeast of a farm home. The neighbors sought both damages and injunctive relief due to odors. (Bundy-Iowa State)

0790 - A5, A6, C3
ORIGINS AND IMPLICATIONS OF ENVIRONMENTAL QUALITY STANDARDS FOR ANIMAL PRODUCTION FIRMS,
Economic Research Service, Washington, D.C. Farm Production Economics Div.
J. B. Johnson, and L. J. Connor.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 102-104. 14 ref.

Descriptors: *Farm wastes, Feed lots, Runoff, Cattle, *Legal aspects, Water pollution control, Federal Government, Local Governments, State Governments, Control, Standards, Regulation.
Identifiers: *Feed lot firms, Nebraska Pollution Control Council.

The alternative measures of minimizing pollution from animal wastes can be categorized as (1) voluntary control measures adopted by animal producers, (2) individual legal actions, and (3) statutes and regulations established by local, State, and Federal Governments. Some individual producers and producer groups have adopted abatement technologies and taken other more drastic measures such as shifting the geographic location of their operations to minimize the pollution potential of their animal production operations. Certain animal production firms have been defendants in legal litigations by plaintiffs seeking to induce changes in the producers' animal production activities. Animal production firms are subject to different forms of private legal litigation, those being (a) trespass, (b) nuisance, (c) negligence, and (d) strict liability. Several local, State, and Federal Government agencies have existing statutes related to the management of animal wastes. Governmental statutes have generally implemented controls on animal production firms by (a) direct regulations such as licenses and registry requirements, (b) payments for installation of particular pollution control devices or lower rates of property tax, and (c) by charges such as fines or excise taxes for discharging excessive amounts of animal pollutants. (Bundy- Iowa State)

0791 - A5, A6, B1
METEOROLOGICAL CONTROL OF MALODORS FROM LAND SPREADING OF LIVESTOCK WASTES,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
R. A. Nordstedt, and E. P. Taiganides.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 107-109, 9 ref, 1 fig.

Descriptors: *Farm wastes, Odors, Meteorology, Air pollution, Model studies, Control, Waste disposal.
Identifiers: Land spreading, Odor nuisance.

One of the foremost problems in land disposal of livestock wastes is the emission of malodorous gases from these wastes and their transport into populated areas through the atmosphere. Therefore, malodors are a constraint on land spreading of livestock wastes. Chemical treatment of these wastes for abatement of malodors is usually quite expensive. The applicability of meteorological control to land spreading of livestock wastes, and the development of an air quality model to predict the odor nuisance potential from land spreading operations were investigated. Simulations with the air quality model have shown that meteorological control of malodors from land spreading of livestock wastes is possible. The model is limited by the need for data on emission rates of malodorous gases from various livestock wastes as well as the properties of these gases. Better dispersal equations and experimental determination of diffusion parameters will also assist in applying the model to field conditions.
(Bundy-Iowa State)

0792 - A5, A6, C3
CHROMATOGRAPHIC IDENTIFICATION OF MALODODORS FROM DAIRY ANIMAL WASTE,
Ohio State Univ., Dept. of Agricultural Engineering, Columbus.
R. K. White, E. P. Taiganides, and G. D. Cole.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 110-113, 5 fig, 2 tab, 8 ref.

Descriptors: *Farm wastes, *Chromatography, Analytical techniques, Odor, Hydrogen ion concentration, Aeration, Sulfur, Organic compounds, Cattle.
Identifiers: *Anaerobic dairy wastes.

Recent trends toward large, confined animal production units and the urban encroachment into agricultural areas have brought into focus the problem of odor nuisance from animal waste. There is a need for identifying satisfactory methods of controlling and abating the odor nuisance from animal waste. Before control techniques can be developed, an analysis of the odors and an understanding of the physical, chemical and biological conditions that help generate them is needed. The objectives of this study were: to separate and identify principal odorous compounds emanating from dairy animal wastes and to measure the effect of aeration on the production of principal odors from dairy animal wastes. Eight odorous compounds were tentatively identified by comparing Kovat Indexes for the principal odorous fractions separated by the gas chromatograph and the Kovat Indexes of known compounds. Also, an organoleptic evaluation of the odors was employed. The compounds tentatively identified using the column selected for hydrocarbons and sulfur compounds were hydrogen sulfide, methanethiol, methyl sulfide, diethyl sulfide, propyl acetate and n-butyl acetate. The amine compounds detected were trimethylamine and ethylamine. Aeration eliminated or diminished the production of the principal odors identified. (Bundy-Iowa State)

0793 - A5, A6, B1, D2
CONTROL OF ODORS FROM POULTRY HOUSES,
Agricultural Research Service, Beltsville, Md. Livestock Engineering and Farm Structures Research Branch.
G. B. Willson.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 114-116, 2 fig, 1 tab, 4 ref.

Descriptors: *Farm wastes, Odors, Dusts, Poultry, Filters, Ammonia, Control, Air pollution.
Identifiers: Water spray system, Pad-type filter, Dry filters, Burlap.

Odor and, to a lesser extent, the dust in ventilation air exhausted from poultry houses constitute an aesthetic nuisance. Use of filters and water spray chambers were evalrated for their effectiveness in removing the odor and dust. Three variations of baffle impingement filters with and without a water spray were tested. Dust removal efficiencies were determined by particle counts on filters through which a measured quantity of air had been drawn. Odor strength was evaluated organolepti-

cally. The baffle impingement filters reduced the odor although they only removed a negligible amount of dust. Introduction of a water spray ahead of the baffle improved the dust removal to around 50% and practically eliminated the odor. Control of odor and dust would enhance the desirability of poultry houses as neighbors. Use of the water spray baffle impingement filters should reduce air pollution complaints.
(Bundy-Iowa State)

0794 - A5, A6, C3, D3

AMMONIA DESORPTION FROM CONCENTRATED CHICKEN MANURE SLURRIES,
Agricultural Research Service, Ithaca, N.Y. Agricultural Engineering Research Div.
A. G. Hashimoto, and D. C. Ludington.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 117-121, 3 fig, 5 tab, 7 ref.

Descriptors: *Farm wastes, *Nitrogen, *Ammonia, Poultry, Hydrogen ion concentration.
Identifiers: *Chicken manure, Fick's Second Law.

The purpose was to determine the parameters affecting ammonia desorption from concentrated chicken manure slurries and to develop an equation to predict the rate of ammonia desorption. Analyses of variance were performed to determine whether any correlation existed between the desorption rate constant and the fraction of undissociated ammonia, (Fu), temperature, air flow, total and volatile solids, initial organic nitrogen concentration and initial ammonia nitrogen concentration. Preliminary analysis indicates that only Fu and temperature have significant correlation with the desorption rate constant under the experimental agitation rates and geometric shape of the reaction vessel. The desorption rate constant may be predicted by an equation of the following form: K/l-Fu = A (T/l-Fu)B where: K= ammonia desorption rate constant (hour-1); T = temperature (deg. F); Fu = fraction of undissociated ammonia; A and B = constants. The amount of base required to maintain the desired pH was recorded to determine which pH range might be the most efficient in stripping ammonia. Below pH 10.0 there is a direct relationship between the ratio of base required to ammonia removed and pH. Above pH 10.0 the ratio is independent of pH.
(Bundy-Iowa State)

0795 - A2, A9, C3, C5

ANTIBIOTIC RESISTANCE AND RESISTANCE TRANSFER BETWEEN BACTERIAL ISOLATES IN A WASTE LAGOON,
North Dakota State Univ., Fargo. Dept. of Bacteriology.
M. Bromel, Y. N. Lee, and B. Baldwin.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 122-125, 2 fig, 6 tab, 11 ref.

Descriptors: *Farm wastes, Liquid wastes, Salmonella, Microorganisms, Cattle, E. coli, Public health, Pathogenic bacteria, Transfer.
Identifiers: *Public health hazard, R factors.

The incidence and pattern of antibiotic resistance in bacterial isolates from liquid and solid bovine wastes and from the Red River of the North were determined by disc assay and tube dilution methods. Subsequent in vitro mating experiments were performed between the enteric members of these two groups of isolates so that the patterns of antibiotic-resistance transfer could be elucidated. Levels of antibiotics present in waste lagoon water and river water were determined by microbiological assay. Complete resistance to aureomycin, terramycin sulfamethazine and sulfaethoxypyridazine was shown by isolates of the genera Salmonella, Proteus, Streptococcus and Escherichia. Developing antibiotic resistance was shown by isolates of the general Shigella and Klebsiella. Drug sensitivity was shown only by clostridial isolates. Successful transfer of multiple drug resistance to sulfamethazine, penicillin and streptomycin was obtained from a Proteus sp. to an Escherichia sp. Results from the matings of the recombinants with drug-sensitive typhoid and dysentry organisms are reported. In some instances, detectable levels of terramycin and aureomycin were found in waste waters. The possibility for drug resistance transfer between organisms in livestock wastes and pathogens in public waters was significantly high and constitutes a potential public health hazard. (Bundy-Iowa State)

0796 - A2, C4

DIFFERENTIATION OF RUMINANT FROM NON-RUMINANT FECAL SOURCES OF WATER POLLUTION BY USE OF ENTERIC BACTERIA,
South Dakota State Univ., Brookings. Dept. of Bacteriology.
P. R. Middaugh, L. R. Koupal, R. L. Pierce, Jr., J. R. Tiede, and J. W. Zerfas.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 126-128, 1 fig, 35 ref.

Descriptors: *Farm wastes, Runoff, *Coliforms, Microorganisms, Bacteria, *Streptococcus, Nitrogen, Cattle, Sheep, Goats, Lagoons, Pollutant identification.
Identifiers: *S. bovis, Fecal pollution.

Studies on methods for improving the land disposal of animal wastes or on methods to minimize storm run-off waste pollution of streams or lakes would be aided if feed lot wastes in water could be differentiated from non-ruminant or human waste sources. A laboratory study was based on the presence of a fecal streptococcus, Streptococcus bovis, in feces of ruminant farm animals, cattle, sheep and goats which have from 1 to 20 million cells per ml. of rumen fluid. In a preliminary survey of fecal streptococci occurring in lakes and rivers and in municipal wastes and a dairy lagoon the predominant organism was Streptococcus faecalis and its varieties which represented 90% of the fecal streptococci. S. bovis constituted only 3% of the streptococci. The standard media used to cultivate gut bacteria were highly inhibitory for S. bovis cells which were added to water samples. An improved medium with reduced sodium azide, 0.02%, improved anaerobic culture conditions and the quantitative collection of the bacteria on membrane filters led to a selective method using a starch hydrolysis overlay. The improved medium quantitatively detected S. bovis bacteria added to river water samples and allowed their routine isolation. Of the isolates, 92% were found to be Streptococcus bovis and 8% were S. faecalis variety liquefaciens. To be an effective pollution indicator, S. bovis must survive sufficiently to be readily detected.
(Bundy-Iowa State)

0797 - C4, E3

GROWTH KINETICS OF RUMEN BACTERIA IN SOLUTIONS OF POULTRY EXCRETA,
Kentucky Univ., Lexington.
H. E. Hamilton, I. J. Ross, J. J. Begin, and S. W. Jackson.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 129-131, 8 fig, 12 ref.

Descriptors: *Farm wastes, Poultry, Feeds, Hydrogen ion concentration, Microorganisms, Growth rates, Cattle.

Poultry excreta contains nutrients that can be utilized as a livestock feed. Successful feeding trials with untreated litter have proven the feasibility of utilizing excreta as a feedstuff. Excreta from hens fed a drug-free diet was blended and diluted with water, sterilized, and placed in a fermentor equipped with an indirectly driven agitator, automatic pH controller, temperature controller, foam controller, and sampling device. The solution was then inoculated with rumen fluid from a steer being maintained on a diet containing sterilized chicken manure and fermented anaerobically for 48 hours. Samples were taken as the fermentation process progressed and diluted and plated for microflora counts. The colonies in the inoculated tubes were counted after 7 days of incubation. There was logarithmic growth beginning about three hours after inoculation and subsiding about ten hours after inoculation. High solids levels decreased the maximum population and increasing and/or decreasing the pH from that in the rumen altered the maximum population.
(Bundy-Iowa State)

0798 - B3, C5, D4

THE ROLE OF MICROORGANISMS IN THE MANAGEMENT OF ANIMAL WASTES ON BEEF CATTLE FEEDLOTS,
Agricultural Research Services, Lincoln, Nebraska.
T. M. McCalla, and L. F. Elliott.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 132-134, 2 fig, 3 tab, 28 ref.

Descriptors: *Farm wastes, Cattle, Feed lots, Microorganisms, Pathogenic bacteria, Nitrogen, Crops, Odors.

Animal wastes on feedlots may leave the feedlot by mechanical removal, runoff, percolation through the soil profile, volatilization, or decomposition. Of these mechanisms, microbial decomposition plays a major role in the rate and route of manure loss. Laboratory and feedlot studies, at Lincoln and Central City, Nebraska, indicate mechanical removal of manure from the feedlot may be necessary only after several years of accumulation. The manure in the feedlot can be mounded to provide a protected drained area for the animals, and the manure serves as a compost pile to aid in decomposition. The feedlot studied is level with a high water table and limited runoff occurs. Laboratory studies have indicated as much as 90% of the nitrogen and 50% of the carbon in the manure and urine can be lost by decomposition in a 4-month period. Soil microorganisms can be managed to reduce odors and to dispose of animal wastes without pollution of surface or ground waters. If the surface of the feedlot is aerobic, many odor-causing compounds can be metabolized before they reach the atmosphere. It may also be desirable to maintain aerobic conditions at the feedlot surface for sanitary reasons. Laboratory studies conducted at Lincoln showed Salmonella sp. added to beef manure died rapidly under aerobic conditions but survived under anaerobic conditions. Feedlot soil atmosphere studies found high concentrations of CH_4 and CO_2.
(Bundy-Iowa State)

0799 - B2

AGITATION IN LIQUID MANURE TANKS,
Tennessee Univ., Knoxville. Dept. of Agricultural Engineering.
J. I. Sewell.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 135-137, 4 fig, 1 tab, 5 ref.

Descriptors: *Farm wastes, Model studies, Liquid wastes, Pumps, Slurries, Design, On-site tests, Cattle, Mixing.

Few problems with agitation were encountered in two full-scale field tests of liquid manure systems at dairies. Adding water to the tanks immediately after emptying greatly facilitated agitation. As the quantity of waste hay, silage, and green chop entering the pits increased, agitation became more difficult. Scraping manure into the tanks before appreciable drying had occurred also facilitated agitation. Minimizing the entry of twine, wood chips, and coarse hay into the pits reduced downtime. While the results of the model studies suggested that best agitation could be achieved in pits equipped with side and center baffles, effective agitation was achieved in pits constructed with cover support columns and without baffles. As the model studies suggested, cover support columns did not adversely affect agitation. In designing liquid manure pits where agitation difficulties are expected, center and side baffles should be considered. (Bundy-Iowa State)

0800 - B2, C2

MEASURING METHOD FOR EVALUATING THE ABILITY TO PUMP SEMI-LIQUID AND MANURE,

Bayerische Landesanstalt ue Landtechnik, Weihenstephan (West Germany).
K. Grimm, and G. Langenegger.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 138-141, 145, 9 fig, 10 ref.

Descriptors: *Farm wastes, Liquid wastes, Pump testing, Measurement, Pumps.
Identifiers: Consistency factor, Manure pump, Manure consistency.

A large number of pumps are on the market; some are very well adapted to pumping liquid manure and some lack several things which one could wish for. A technical measurement for the capacity of individual pumps to boost liquid manure is necessary in order to put the individual pumps to work at the correct place and to be able to plan liquid manure installations. Tests haves shown that all semiliquid and liquid manure mixtures may be evaluated in a relatively simple way insofar as the ability to be pumped is concerned. Measuring manure consistency by the ball method is described. This method of measuring provides a uniform prerequisite for testing pumps and thereby makes an exact examination possible with varied semi-liquid manure mixtures with different consistencies. (Bundy-Iowa State)

0801 - A3, B2, C2, C3, C4

PUMPING CHARACTERISTICS, BIOLOGICAL AND CHEMICAL PROPERTIES OF DAIRY MANURE SLURRIES,

British Columbia Univ., Vancouver. Dept. of Agricultural Engineering.
L. M. Staley, N. R. Bulley, and T. A. Windt.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 142-145, 6 fig, 2 tab.

Descriptors: *Farm wastes, Cattle, Irrigation, Biochemical oxygen demand, Hydrogen ion concentration, Potassium, Sodium, Chloride, Ammonium, Sprinkler irrigation, Waste disposal, Design pumps.
Identifiers: *Dairy, Piping losses.

A manure handling system has been designed to permit a zero grazing management practice and utilize above ground storage and sprinkler irrigation methods of waste disposal. Manure from the exercise yard and holding area is scraped into a 288 cubic foot below grade sump. From this point the complete system is operated by a 30 HP electric motor and Holz helical type manure pump. The pump is used for filling the 100,000 US gallon above ground storage tank; for agitation and mixing within the tank and returning the slurry to the sump for dilution if necessary, before pumping through a 4 inch diameter aluminum irrigation system to a standard No. 104 Rainbird sprinkler. BOD, COD, pH, ammonia, organic and nitrate nitrogen, total and ortho phosphate, sodium, potassium, chloride, total volatile and suspended solids were determined at bi-weekly intervals for (1) water inputs, (2) manure into and out of storage and (3) water outflows from field drains. Sampling began June 2, 1970 and will continue throughout the winter season. (Bundy- Iowa State)

0802 - A5, B1, D4, E3

AUTOMATED HANDLING, TREATMENT AND RECYCLING OF WASTE WATER FROM AN ANIMAL CONFINEMENT PRODUCTION UNIT,

Ohio State Univ., Columbus. Dept. of Agricultural Engineering.
E. P. Taiganides, and R. K. White.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 146-148, 4 fig, 3 ref.

Descriptors: *Farm wastes, Confinement pens, Oxidation, Odors, Dusts, Aerobic treatment, Biological oxygen demand, Waste water treatment, Water reuse, Hogs.
Identifiers: *Automatic flushing, Flushing tanks, Solids separator, Fuch's oxygenator.

Manure is flushed out by flooding the gutters of a confinement building where 500 pigs are raised from 20 to 220 lbs. This way no labor is needed to scrape the manure out plus no offensive odors are released into the building because of frequent flushing. The flushed wastewater is pumped onto a screen which separates the solids from the liquid. The solids are aerobically digested, deodorized and stored before final disposal onto agriculturally productive land. The liquids separated at the screen are discharged into an oxidation ditch. Ditch effluent is clarified and the supernatant is pumped back into the building as flushing water. Provisions to disinfect the recycled water for odor and disease control are present in the system. Laboratory-scale model was tested to arrive at maximum loading rates for odor control. Four loading rates ranging from 30-80 lbs VS/1000 ft/day were tested. Preliminary results show that hourly loading is better than daily slug loading. All loading rates can be effective, but the higher rates require closer supervision. Odors given off are ammonia-like at first but change to earthy or musky inoffensive odors after the 6th day. Foaming was much greater with slug loading. However, the settling characteristics of the slug-load unit were better than hourly-loading. (Bundy-Iowa State)

0803 - D4, E3

MANURE MANAGEMENT IN A 700-HEAD SWINE-FINISHING BUILDING; TWO APPROACHES USING RENOVATED WASTE WATER,

Iowa State Univ., Ames. Dept. of Agricultural Engineering.
R. J. Smith, T. E. Hazen, and J. R. Miner.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 18-22, 1971, p 149-153, 7 fig, 2 tab, 14 ref.

Descriptors: *Farm waste, Confinement pens, Swine, Chemical oxygen demand, Settling, basin, Oxidation treatment, Sludge, Water reuse.
Identifiers: *Flushing gutter, Anaerobic lagoon.

Iowa State University had used fresh water for flushing manure from a confinement building but difficulties in effluent disposal stopped this practice. Two systems of waste water renovation were examined. Preliminary studies showed that adequate manure removal and reduced water use could be obtained by intermittent discharge of a tank of cleaning water. Mechanisms for controlling such discharge are described. The presence of an open flushing gutter in the pen area was found to affect defecation habits very favorably, also the action of the pigs' feet improved manure transport. The effect on the pigs of exposing them to their renovated effluent was unknown; hence, the first scheme included an anaerobic lagoon followed by an oxidation ditch, both external to the building. Total sludge return to the oxidation ditch was used by incorporating a settling tank. Conventional sanitary engineering measurements were made at various points in the cycle; these included oxygen demand, solids, various inorganic ions and a membrane filter count of coliform density. Tests were started in January 1969, and it was found that a stable, odorless effluent of less than 150 mg/l BOD5 could easily be obtained, even at low ditch temperatures. (Bundy-Iowa State)

0804 - B2

IMPROVING WATER UTILIZATION EFFICIENCY IN AUTOMATIC HYDRAULIC WASTE REMOVAL,

Agricultural Research Service, Beltsville, Md. Agricultural Engineering Research Div.
E. E. Jones, G. B. Willson, and W. F. Schwiesow.
In: Livestock Waste Management and Pollution Abatement, Proceedings, International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 154-158, 11 fig, 8 ref.

Descriptors: *Farm wastes, Velocity, Automation, Hogs, Water utilization.
Identifiers: *Automatic hydraulic waste removal, Flush tank.

One of the goals of the USDA Farmstead Water Systems Research is to improve water utilization efficiency in livestock sanitation. Reports of large volumes of water being used to remove solids from under slotted floors led to theoretical and model studies of automatic hydraulic waste removal in 1963. In 1966 certain principles developed from these studies were incorporated in a partically slotted floor swine building. A maximum design flush volume of 3 gallons per pig (300 gallons) was used. Movie film analysis of waste removal revealed that as much as 90% of the water was discharged clear at the end of the gutter. Reducing flush volume to 160 gallons resulted in incomplete waste removal. Major factors limiting water utilization efficiency have been identified and verified in design modifications. Unsteady flow conditions and the modification of fluid properties by dissolved and suspended solids result in velocities about 30% higher than predicted by Manning's formula. Above velocities of 3 fps the relationships between waste deposition, depth of flow and duration of flow determine water utilization efficiency. Automatic hydraulic waste removal by making possible daily or more frequent waste removal will provide a better livestock environment at less cost. (Bundy-Iowa State)

0805 - D4

HIGH RATE POULTRY MANURE COMPOSTING WITH SAWDUST,

North Carolina State Univ., Raleigh. Dept. of Civil Engineering.
W. S. Galler, and C. B. Davey.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 159-162, 9 fig, 2 tab, 2 ref.

Descriptors: *Farm wastes, Poultry, Aerobic treatment, Carbon, Nitrogen, Grains, Cation exchange, Crop response, Waste treatment.
Identifiers: *Composting, Sawdust.

The feasibility of high rate, thermophilic composting of animal wastes mixed with carbonaceous materials and the affect of the compost on plant growth were investigated. Poultry manure and sawdust were initially selected in order to get the proper moisture content and carbon to nitrogen ratio (C:N). Each batch was characterized chemically in order to determine the moisture content, the proper C:N and available phosphorus, potassium, calcium, and magnesium. Sixteen batch studies were made using a 45 cubic foot rotating drum approximately two-thirds full. The composting mass was aerated continuously. The effects of aeration, agitation, C:N, and moisture content were studied. The pH, temperature, and oxygen uptake were studied for each run. Mass balances were made to determine nitrogen losses. Cellulose degradation was also studied. After removal from the composter, cellulose degradation took place as a fungus developed in the pile. The cellulose content decreased during the storage phase by over 25% in four to six weeks while the cation exchange capacity rose from 35 milli-equivalents per 100 grams to 67 milli-equivalents per 100 grams. Nitrogen losses for the properly run process averaged about 3.5%. The final product had a blackish-white color and an odor resembling a fresh humus soil. Greenhouse studies were made using tomatoes, wheat, millet and greenbeans. The plants were planted in soil compost mixture ranging from 0% to 100% compost by weight.
(Bundy-Iowa State)

0806 - D4

COMPOSTING DAIRY COW WASTES,
Agricultural Research Service, Beltsville, Md. Livestock Engineering and Farm Structures Research Branch.
G. B. Willson.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 163-165, 4 fig, 2 tab, 4 ref.

Descriptors: *Farm wastes, Aerobic treatment, Cattle, Hay, Silage, Grains, Odor, Waste treatment.
Identifiers: *Composting.

Composting is a biological process for the degradation of solid wastes. It has been used to reduce municipal wastes to an odorless, stable material that may be used as a soil conditioner. The compost may be easily handled or stored. Like other biological degradation processes, the process may be either aerobic or anaerobic or a combination. The aerobic process is faster and produces more heat, which maintains the elevated temperatures required. The aerobic process, which seems to have merit for treatment of farm animal wastes, was studied. Waste from the gutter of a stanchion barn was used. Two types of bedding, straw and wood sawdust, were evaluated. Several of the process parameters have been investigated on a pilot scale with approximately one-half ton batches and on a bench scale. These parameters include air flow rate, moisture content, temperature, pH, and agitation frequency. Dry matter was reduced about 60%. The total weight was reduced about 80%, including the effect of lowering the moisture content from 75 to 50% during the process. Volume was reduced 30 to 50% on a loose basis. The final product has a faint musty odor in a moist condition. It is odorless when air-dried to about 10% moisture content.
(Bundy-Iowa State)

0807 - A2, B1, C1, C5, E1

QUALITY OF EFFLUENT FROM FARM ANIMAL PRODUCTION SITES,
Louisiana Tech Univ., Ruston. Dept. of Agricultural Engineering.
J. W. D. Robbins, G. J. Kriz, and D. H. Howells.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 166-169, 5 fig, 4 tab, 4 ref.

Descriptors: *Farm wastes, Coliforms, Biochemical oxygen demand, Chemical oxygen demand, Carbon, Lagoons, Runoff, Water pollution sources, Water pollution control, Waste disposal.

Effluents from twelve animal production sites representing three types of waste management operations--land disposal, lagooning and direct discharge into streams--were measured and more than 1500 samples were collected for analyses. The water samples were analyzed for (a) bacterial densities--total coliforms, fecal coliforms and fecal streptococci; (b) degradable organics--biochemical oxygen demand, total organic carbon, total solids and volatile solids; and (c) nutrients--organic nitrogen, ammonia nitrogen, nitrate nitrogen, nitrite nitrogen, total phosphate and orthophosphate. Other measurements included pH, conductivity, initial dissolved oxygen and temperature. Site data were collected in order to evaluate the pollutional potential of each site and the management factors determining the amount of wastes that reached water courses. These data included the number and size of animals, types and amounts of foods, types of waste handling facilities and practices, waste retention or drainage times, soil classifications, rainfall, temperature, flow rates and some characterization of wastes produced. Study results point to the need for and superiority of land disposal for animal wastes to effectively control water pollution. Direct dumping of animal wastes into streams is essentially predictable by characterization of fresh wastes and should be prohibited. Effluents from waste lagoons were found to exceed raw domestic sewage in strength and should not be discharged without further treatment. (Bundy-Iowa State)

0808 - D4

WATER HYACINTHS TO FURTHER TREAT ANAEROBIC LAGOON EFFLUENT,
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
J. R. Miner, J. W. Wooten, and J. D. Dodd.
In: Livestock Waste Management and Pollution Abatement, Proceedings, International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971. p 170-173, 4 fig, 7 tab, 10 ref.

Descriptors: *Farm wastes, Water hyacinth, Aerobic treatment, Oxidation lagoons, Nitrogen, Phosphorus, Chemical oxygen demand, Waste water treatment.
Identifiers: *Anaerobic lagoon effluent.

Effluent from an anaerobic lagoon treating liquid swine manure was pumped through a series of four pools, each ten feet in diameter. Water hyacinths were grown on these pools in an effort to provide further treatment. The plants flourished, necessitating weekly harvesting of one-fourth of the growth. During the month of July 1970, nine pounds of ammonia were added to the system in the influent and less than one-fourth pound discharged in the effluent. During this same period, 28 pounds of COD were added and 2.6 pounds discharged. Extrapolating the system to a per acre basis indicates ammonium nitrogen removal to be in excess of 35 pounds per acre per day, COD removal to exceed 100 pounds per acre per day and phosphate removal to exceed 15 pounds per acre per day. Nitrate release was less than 0.3 pounds per acre per day. In one sample weekly harvest (Aug. 14 - Aug. 21), 450 plants with a total wet weight of 90 lbs. were removed from two of the ponds having a combined area of approximately 160 sq. ft. This corresponds to an increase of over 17,000 new plants per acre per day and an increase in wet weight of over 2500 pounds per acre per day. At a 4% dry weight conversion factor, this equals 100 pounds of dry weight per acre per day. The system has performed satisfactorily showing potential as a means of removing nutrients from partially treated animal wastes which are not removed by currently used processes. (Bundy-Iowa State)

0809 - D4

ENZYME-FACILITATED MICROBIAL DECOMPOSITION OF CATTLE FEEDLOT MANURE,
Colorado State Univ., Fort Collins. Dept. of Microbiology.
G. K. Elmund, S. M. Morrison, and D. W. Grant.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971. p 174-175, 4 fig, 7 ref.

Descriptors: *Farm wastes, Cattle, Feed lots, Enzymes, Biochemical oxygen demand, Microbial degradation, Amino acids, Proteins.
Identifiers: *Enzymatic hydrolysis.

The cleavage of the macromolecular fraction is a rate-limiting step preceding its oxidation or assimilation during the initial microbial decomposition of cattle feedlot manure. Increasing the initial rate of hydrolysis of the macromolecules may stimulate the development of a microflora actively involved in the subsequent stages of the decomposition process. Methodologies have been developed to evaluate and optimize conditions for enzymatic hydrolysis of manure substrates as well as bioassay techniques to measure the resultant increased rates of microbial activity. The results of studies with proteolytic enzymes are presented as a model system. Fresh manure from feedlot cattle receiving a high concentrate ration was exhaustively dialyzed, lyophilized and ground in a Waring blender. The non-dialyzable manure components contained 94 percent of the dry matter of fresh manure. The material contained 275 mg/gm protein of which 75 mg/gm was soluble protein. After three hours incubation with Pronase B grade (Calbiochem), essentially all of the soluble and 17.5 percent of the insoluble protein was hydrolyzed. Enzymatic hydrolysis of the protein fraction of feedlot manure appears to significantly increase the initial rate of microbial oxidation of the manure substrate. The results give promise to the use of hydrolytic enzymes to facilitate the overall rate of manure decomposition.
(Bundy-Iowa State)

0810 - A2, C3, C4

WATER AND SOIL OXYGEN DEMAND OF LIVESTOCK WASTES,
Ohio State Univ., Columbus. Dept. of Agricultural Engineering.
E. P. Taiganides, R. K. White, and R. L. Stroshine.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971. p 176-179, 7 fig, 4 tab, 7 ref.

Descriptors: *Farm wastes, Sulfur, Carbon, Nitrogen, Waste treatment, Biochemical oxygen demand, Analytical techniques.
Identifiers: *Soil oxygen demand, Winkler method, Warburg respirometer.

The oxygen demands of animal manures placed in a water environment were measured using the standard BOD dilution-bottle technique and the Warburg respirometer method, using seeded and unseeded samples and incubating the samples at temperatures ranging from 12 deg. C to 28 deg. C. It was concluded that oxygen demand units should be reported in mg O2 per gram of total solids (mg/g TS) or as percent of TS. Seeding animal manure samples with supernatant from aerated sewage produced a significantly higher BOD curve than for unseeded samples. Total BOD (56 days at 20 deg. C) of animal manure constituted 40 to 50 percent of the COD, but the 5-day BOD is less than 14 percent of the COD of the same waste. Either the

Winkler method or oxygen meter may be used with similar accuracies in the measurement of dissolved oxygen in BOD bottles. Warburg respirometer is a good apparatus to use to determine oxygen demand of animal wastes. A test to measure the rate and ultimate oxygen demand of animal manure incorporated into top soil is called Soil Oxygen Demand (SOD). In the SOD test, waste is placed in an air-tight Warburg flask containing soil. As microbes decompose the waste, oxygen is consumed and carbon dioxide is released. The carbon dioxide is absorbed by a solution of 40 percent potassium hydroxide which is placed in a vial in the flask. The quantity of oxygen consumed is determined by measuring changes in the pressure in the flask and calculating the change in quantity of gas, using the ideal gas law. (Bundy-Iowa State)

0811 - C3, C4

BOD ANALYSIS OF SWINE WASTE AS AFFECTED BY FEED ADDITIVES,
North Carolina State Univ., Raleigh. Dept. of Biological and Agricultural Engineering
J. D. Ariail, F. J. Humenik, and G. J. Kriz.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 180-182. 8 fig, 3 ref.

Descriptors: *Farm wastes, Swine, Biochemical oxygen demand, Copper, Zinc, Sewage, Lagoons, Analytical techniques, Feeds.
Identifiers: *Feed antibiotics.

The effects of feed antibiotic, copper and zinc concentrations, and sample dilution upon the standard BOD5 analysis for swine wastes were investigated. Analyses were made on swine feces, lagoon influent and lagoon effluent. Antibiotic concentrations in the swine waste were found by modifying the AOAC (1965) microbiological method for the assay of chlortetracycline in animal feeds. The copper and zinc concentrations of digested samples were determined with an atomic absorption spectrophotometer. The amount of each inhibitory substance present in the BOD bottle for the various sample dilutions was determined. The amount of metal or antibiotic present was related to the amount of organics. Therefore all BOD dilutions that result in an acceptable oxygen depletion have similar concentrations of organics and inhibitory substances. Recommendations presented for the selection and determination of the most reliable BOD5 data for animal waste are different from commonly accepted criteria for obtaining the statistically best BOD5 results for domestic and industrial wastewater. The membrane filter technique outlined in Standard Methods for the determination of the fecal streptococcus content of sewage and animal waste is superior to the membrane filter technique utilizing Bacto-KF streptococcus broth.
(Bundy-Iowa State)

0812 - C4, D4

PORCINE ENTEROVIRUS SURVIVAL AND ANAEROBIC SLUDGE DIGESTION,
Illinois Univ., Urbana. Dept. of Microbiology; and Illinois Univ., Urbana. Dept. of Veterinary Pathology and Hygiene.
R. C. Meyer, F. C. Hinds, H. R. Isaacson, and T. D. Hinesly.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 183-184. 2 fig, 1 tab, 6 ref.

Descriptors: *Farm wastes, Sludge digestion, Viruses, Swine, Anaerobic digestion.

Little information is available on the effect of anaerobic sludge digestion upon viruses. Laboratory anaerobic digesters of 1 liter capacity were set up in duplicate employing sludge obtained from the local municipal sewage treatment plant. The digesters were monitored and upon stabilization after 4 to 5 days, they were seeded with 100 ml. of a virus suspension containing 10 deg PFU/ml. of a swine enterovirus. At time intervals ranging from 1/2 hr. to 12 days 25 ml. samples were withdrawn from each digester and pooled. The presence of infectious virus in the respective samples was determined by the capacity of a 20 ml. volume, upon oral administration, to infect 10-14 day old germfree piglets. Fecal samples were collected from each pig twice a day (A.M. and P.M.) on the 3rd and 4th day post challenge and pooled. Possible infection of piglets by the indicator virus was determined by standard virologic procedures employing diploid porcine kidney cell cultures. Virus, when recovered from the piglets was identified by serologic procedures as the test agent. Virus could not be detected or demonstrated by pig challenge after the 4th day in the anaerobic digesters.
(Bundy-Iowa State)

0813 - A5, D2

THROUGH-CIRCULATION DRYING OF MANURE IN SUPERHEATED STEAM,
Drexel Univ., Philadelphia, Pa. Dept. of Chemical Engineering.
J. R. Thygeson, E. D. Grossmann, and J. MacArthur.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 1[illegible]-189. 7 fig, 1 tab, 6 ref.

Descriptors: *Farm wastes, *Drying, Odor, Moisture content, Waste treatment, Waste disposal, Steam.
Identifiers: *Superheated steam, Continuous conveyor dryer.

Treatment of livestock waste to produce a biochemically stable and odor free product capable of use as a feed additive, soil conditioner, or fuel is described. The process involves the drying of a packed bed of wet manure extrusions in a closed cycle system employing superheated steam as the drying medium. The prospective advantages of this method of waste treatment include: (1) high production rate per unit area of plant; (2) minimum environmental pollution associated with the process; (3) relative insensitivity to changes in environmental and feed conditions; (4) capability of treating the undiluted manure; (5) production of a stable, odorless, free-flowing solid convenient for storing or transporting. Preliminary experimental studies on the extrudability of the wet manure and on the pressure drop and drying characteristics of the packed bed indicate that the material can be dried successfully in a through-flow system. The steam was forced through the bed of wet extrusions in a laboratory-scale test apparatus which permitted easy removal of the test section for periodic weighing. The equipment was capable of achieving the following limits on the drying parameters: bed depth of 9 inches; superficial velocity of 1080 feet per minute; fluid temperature of 350 deg F; superheat equivalent to 140 deg F. Provision for pressure drop, flow, and temperature measurement was incorporated in the system.
(Bundy-Iowa State)

0814 - D3

PYROLYSIS OF LIVESTOCK WASTES,
Ohio State Univ., Columbus. Dept. of Agricultural Engineering.
R. K. White, and E. P. Taiganides.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 190-191. 3 fig, 3 tab.

Descriptors: *Farm wastes, Anaerobic conditions, Poultry, Swine, Cattle, Thermal capacity, Odor, Waste treatment, Incineration.
Identifiers: *Pyrolysis.

Pyrolysis is the 'anaerobic' incineration of wastes in contrast to combustion which might be termed 'aerobic' incineration. Pyrolysis is the chemical decomposition of materials heated to high temperatures in the absence of free oxygen. Animal manures were heated to 800 deg C at a controlled rate and in an airtight vicor tube placed inside a standard muffle furnace. The released gases were collected by displacing a brine solution and their composition was determined by a standard burrett gas analyzer. Quantities of gas produced and their average compositions are tabulated. Advantages of pyrolysis include the production of gases which can be reclaimed for heat energy and a dry and innocuous residue product with reduced volume.
(Bundy-Iowa State)

0815 - D2

DRYING POULTRY WASTE,
Michigan State Univ., East Lansing. Dept. of Agricultural Engineering.
T. C. Surbrook, C. C. Sheppard, J. S. Boyd, H. C. Zindel, and C. J. Flegal.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 192-194. 4 fig, 4 tab, 5 ref.

Descriptors: *Farm wastes, Odor, Drying, Proteins, Poultry, Potassium, Phosphorus, Temperature, Time, Storage.
Identifiers: Pneumatic drying process, High temperature drying.

Experiments were conducted to evaluate a commercial poultry excreta drier and to minimize nutrient losses in the resulting product. The output of this machine was 340 pounds per hour of dried poultry waste. Drying is a potential way of handling poultry wastes from an economic standpoint. The final product, dried poultry waste, is in a form which can be easily handled. Samples of dried poultry excreta show a wide (11-38 percent) variation in protein content. From 50 to 65 percent of the available protein remains in the dried poultry waste. Trials were conducted to relate protein loss to the amount of heat as measured at one point in the drier. In temperature ranges from 430 deg to 700 deg F, there was a range of three percent on a dry basis from the same unprocessed waste. Generally speaking, the low range of temperatures were less destructive of protein. There is a relationship between protein loss and storage time. This is not evident for 14 days or less storage time. Protein loss is evident for storage periods of four to six months in commercial poultry houses.
(Bundy-Iowa State)

0816 - B1, F1

ECONOMICS OF WASTE DISPOSAL FROM CONFINED LIVESTOCK,
Purdue Univ., Lafayette, Ind. Dept. of Agricultural Economics.
W. H. M. Morris.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 195-196. 4 tab, 3 ref.

Descriptors: *Farm wastes, *Economic feasibility, *Waste treatment, Aerobic treatment, Costs, Fertilizers, Nutrients, Waste disposal, Oxidation lagoons.
Identifiers: *Field spreading.

The costs of handling livestock wastes must be considered in the framework of the total production system, and this may change the location, volume, consistency, and composition of the waste. Furthermore, such items as slotted floors and oxidation ditches often comprise a large part of the total cost of a building. Under U.S. conditions, the cost of disposal of livestock wastes exceeds their value. No one system of disposal is the least costly or the most profitable under all circumstances. Factors such as the cost of labor and of capital and availability of land in different seasons determine the economically optimal system. No profitable method can be foreseen for industrial or domestic utilization of any significant part of the livestock waste produced. It is expected that the producer will continue to use the presently available systems of disposal for the foreseeable future. Spreading on land, anaerobic, and aerobic treatment and feeding all seem practical alternatives. The economic choice depends on the species, the environment, and many other factors. (Schmitt-Iowa State)

0817 - B1, F1, F3

MARKETING CONVERTED POULTRY MANURE,

Pennsylvania State Univ., University Park. Dept. of Animal Industries.
H. C. Jordan.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 197-198.

Descriptors: *Farm wastes, *Fertilizers, *Nutrients, *Poultry, Market value, Byproducts, Odor, Nitrogen.
Identifiers: *Compost, Soil conditioner.

Surveys were sent to firms engaged in processing and marketing poultry manure as a fertilizer or organic soil conditioner. The needs for a marketable product are: (1) Total anaerobic microbe count must be reduced through drying to control odor; (2) Odor must be reduced to nil and then may be masked with a plesant odor for lawn and garden trades; (3) Nitrogen in the form of urea and uric acid must be stabilized so that it is not released quickly and does not burn plants for lawn and garden sale; (4) The product must flow through a lawn spreader and be easy to handle for lawn and garden trade; (5) The product must be stored in bags without picking up water and giving off odor for lawn and garden market; (6) Advertising and sale must be done without 'poultry manure' in the name of the product because of consumer or buyer resistance, with the possible exceptions of industrial sales and naming an organic product 'composted poultry manure'. One may need to guard against negative advertising of odors, diseases, burning plants, and drawing flies.
(Schmitt-Iowa State)

0818 - D1, E1, F1

THE ECONOMICS OF SWINE WASTE DISPOSAL,

Environmental Research and Applications, Inc., Wilton, Conn.
R. W. Okey, and S. Balakrishnan.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 199-203. 5 fig, 8 tab, 26 ref.

Descriptors: *Farm wastes, *Costs, *Economic feasibility, Aerobic treatment, Nitrification, Denitrification, Waste treatment, Waste disposal, Phosphorus.
Identifiers: Phosphorus removal.

It is desirable to codify and apply research findings from several applicable disciplines and to review the cost/effectiveness ratio of waste treatment procedures in the light of new pollution control laws. The essential requirements of treatment are considered to be the total stabilization of carbonaceous and nitrogenous materials with no creation of odors. Possible treatment methods include (1) ground disposal, (2) lagoon storage, (3) total oxidative treatment, (4) organic solids separation and treatment of the liquid stream, (5) primary treatment plus nitrogen and/or phosphorus removal and/or dissolved solids removal. The costs for waste treatment for a 5,000 animal swine system ranged from $17,600 for a 'solids separation prior to oxidative conversion of ammonia' system to $35,500 per year for a 'basic oxidation treatment with nitrogen and phosphorus removal' system. If total solids removal was required, the overall management costs of either system would be increased by $7,300 by adding a membrane system to remove all the inorganics. In addition, a satisfactory point of ultimate disposal must be found for the solids which were separated out. For small livestock systems, the cost per unit will be increased slightly for most treatments.
(Schmitt-Iowa State)

0819 - B1, F1, F3

ECONOMIC IMPLICATIONS OF ENVIRONMENTAL QUALITY LEGISLATION FOR CONFINED ANIMAL FEEDING OPERATIONS,

Oklahoma State Univ., Stillwater. Dept. of Agricultural Economics.
D. D. Badger, and G. R. Cross.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 204-207. 5 fig, 5 ref.

Descriptors: *Farm wastes, *Confinement pens, Costs, Regulation, Farm lagoons, Cattle, Hogs, Oklahoma, Waste treatment.

Recently instituted air and water quality standards and resulting State legislation have caused confined animal feeding operators to invest considerably more in construction and operation of their production system. Approaches being used to handle the animal waste and water runoff problem include stockpiling of manure, land spreading, use of oxidation ditches, and use of stabilization ponds. Beef wastes are handled mainly by scraping, loading, hauling, and dumping. Costs for this type of handling are 0.15 to 1.0 cents per pound of gain for sizable feedlots. Hog operations are generally either pasture, feeding flow-no lagoons, slotted or solid feeding floor with adjacent lagoon, or slotted floor with lagoon directly below. Pasture systems had waste handling costs of 0.5 to 0.1 cents per pound of gain, solid feed floor-no lagoon systems had costs of 1 to 0.2 cents per pound, and totally slotted floors had labor costs of 0.5 to 0.3 cents per pound of gain. Implications are that site selection will be much more critical in the future. Increased use of zoning to keep incompatible operations and urban areas separated will be necessary. (Schmitt-Iowa State)

0820 - A2, B1, F1

COST OF MAINTAINING SPECIFIED LEVELS OF WATER POLLUTION CONTROL FOR CONFINED CATTLE FEEDING OPERATIONS FOR THE SOUTHERN HIGH PLAINS,

Texas Tech Univ., Lubbock. Dept. of Agricultural Economics.
H. Y. Lee, and T. R. Owens.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 207-208. 1 fig, 5 ref.

Descriptors: *Farm wastes, *Cattle, *Agricultural runoff, Confinement pens, Feed lots, Costs, Texas, Water pollution control.
Identifiers: *Southern High Plains.

The Southern High Plains of the U.S. has witnessed the rapid expansion of confined cattle feeding operations. From less than 500,000 head of fed cattle marketed in 1959, the figure increased to over 2.5 million head by 1969 in the state of Texas alone. Surplus feed grain supply, abundant feeder cattle supply, dry and mild climate, gentle terrain, and an excellent transportation network contributed to the development. Some of these factors have also contributed to serious water pollution problems. An immediate solution to the problem might be the utilization of collection basins to collect feedlot runoff for subsequent discharge to an open field or modified playa lake or alternatively left for natural evaporation. The two runoff control systems are termed, respectively, 'mechanical discharge systems' and 'evaporative discharge systems'. Annual costs would range from $1,011 to $3,125 for 5,000 and 25,000 head lots, respectively. This is an average cost of 8.2 cents per head of occupancy. Disposing of solid manure is still a major problem with these systems. A 'modified environment system' consisting of concrete slotted floors and a roof covering the pen area and collection pits appears promising. This type of construction is estimated at about $75 per head, compared with $25 per head for a typical cattle feedlot.
(Schmitt-Iowa State)

0821 - B2, D4

AN OXIDATION DITCH FOR THE HANDLING AND TREATMENT OF POULTRY WASTES,

Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
R. C. Loehr, D. F. Anderson, and A. C.
Anthonisen.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 209-212, 5 fig, 3 tab, 5 ref.

Descriptors: *Farm wastes, *Aeration, *Aerobic treatment, *Poultry, Biochemical oxygen demand, Chemical oxygen demand, Waste storage, *Waste water treatment, *Oxidation lagoons.

An oxidation ditch was used to handle and treat poultry wastes from a cage layer operation. The results showed that an oxidation ditch is a reasonable alternative for handling, treatment and disposal of poultry wastes where odor control, liquid waste handling and reduction of the oxygen demand are desirable or necessary goals in a poultry operation. Mixed liquor should not be disposed of in surface waters; however, land disposal is an acceptable disposal method. There was no overflow from this ditch due to the high evaporation rate. The ditch acted as an aerated holding tank. Total solids exceeded 9% when the ditch was emptied after 274 days of operation. BOD5 was 4200 mg/l and total nitrogen was 3800 mg/l when the ditch was emptied in January 1971. Balances on the system showed 53 percent total solids, 62 percent volatile solids, 83 percent BOD5, 63 percent COD, and 31 percent of the total nitrogen were lost over the 274 day run. The original volume of the ditch was 1200 gallons. To offset 2100 gallons of evaporation, a total of 2900 gallons of water was added intermittently. After startup, the pH ranged from 5.0 to 6.5. Air flow in the control chamber was 3 to 5 cfm per bird for the 246 birds. (Schmitt-Iowa State)

0822 - B2, D4

DESIGN, INSTALLATION AND BIOLOGICAL ASSESSMENT OF A PASVEER OXIDATION DITCH ON A LARGE BRITISH COLUMBIA SWINE FARM,

Department of Agriculture, Abbotsford (British Columbia).
T. A. Windt, N. R. Bulley, and L. M. Staley.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 213-216. 1 tab, 7 fig, 11 ref.

Descriptors: *Farm wastes, *Aeration, *Oxidation lagoons, Hogs, Waste Storage, Biochemical oxygen demand, *Waste water treatment, Odor.
Identifiers: Pasveer ditch.

One 350 to 400 hog unit of a 25,000 commercial swine enterprise was equipped with a Pasveer oxidation ditch. The ditch was a capacity of 3,000 cubic feet and is approximately 220 feet long, 3 feet deep, and filled and maintained at a 22 inch liquid level. Hogs were placed in the structure in early June 1970. Foaming occurred about one month after placement and was controlled with an antifoam agent. The oxidation ditch has given complete odor control of the waste. The effluent from the ditch is easily handled by most pumps for final disposal. The cost of operating the 5 horsepower rotor for the ditch was about 25 cents per finished hog, at an electricity cost of 1.1 cents per Kw-hr. The oxygen concentration in the ditch measured at two-week intervals has varied from 3 to 6 ppm oxygen. The theoretical loading rate of volatile solids was based on a value of 5.9 pounds of volatile solids per day per 1000 pounds of live weight. The BOD has ranged from 600 to 2,000 ppm in the oxidation ditch, compared with a BOD value of 40,000 ppm for the raw 2aste. There seems to be a cyclic nature to the quality of contents in the oxidation ditch but this is not completely understood. (Schmitt-Iowa State)

0823 - D4, F4

BEEF WASTES AND THE OXIDATION DITCH TODAY AND TOMORROW,

Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.
R. E. Larson, and J. A. Moore.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 217-219. 4 ref.

Descriptors: *Farm wastes, Aeration, *Oxidation lagoons, Waste storage, Cattle, Biological oxygen demand, *Waste water treatment.

The oxidation ditch can be operated as a batch system for treatment of beef animal wastes in cold climates. Its role as a management system, however, will be limited to that of collection, odorless temporary storage and partial treatment. Secondary and complete treatment of wastes will probably be accomplished by land disposal. In areas with below zero winter temperatures, a 'ditch' can be operated successfully for a 150-day batch period. After starting with a loading rate of 50 cu. ft. per animal, the solids concentration builds up to about 10-11%, which appears to be a maximum for successful operation. An estimated 20-30% REDUCTION IN SOLIDS HAS BEEN ACCOMPLISHED. These results and the other measured parameters indicate the design criteria for use of the oxidation ditch for beef systems will be very critical and additional research is necessary. There is also a need to study the interrelation between ventilation system design and the efficient operation of the ditch. Solids handling, especially with high roughage and whole grain rations, present some unsolved problems. (Schmitt-Iowa State)

0824 - D4

AEROBIC TREATMENT OF LIQUID AND SOLID POULTRY MANURE,

Guelph Univ. (Ontario).
J. Pos, R. G. Bell, and J. B. Robinson.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 220-224. 7 tab, 6 fig, 11 ref.

Descriptors: *Farm wastes, *Oxidation lagoons, Biodegradation, Nitrification, Denitrification, Aeration, Poultry, Waste storage, *Waste water treatment.
Identifiers: *Compost.

Effects of aerobic treatment on liquid and solid poultry manure have been evaluated in a number of pilot studies. The changes in composition of liquid manure continuously aerated in 'fill and draw' oxidation ditches have been monitored over a number of 28-day storage periods over the last two years. While BOD reductions were less than had been expected on the basis of theoretical rotor efficiency, losses of nitrogen caused by nitrification-denitrification were very large and exceeded 50% of input as soon as active population of nitrifiers had become established. Solid manure aeration was evaluated in a drum fitted with an internal mixing rotor. The input consisted of equal volumes of poultry manure and soft wood shavings. The compost when discharged, after six days retention within the machine, was dark brown in color and had a strong but short-lived odor of ammonia. Although not completely stabilized, the compost could nevertheless be stored for extended periods of time without developing objectionable odors. (Schmitt- Iowa State)

0825 - C4, C5, D4

MICROBIOLOGICAL ASPECTS OF AEROBICALLY TREATED SWINE WASTE,

School of Agriculture, Aberdeen (Scotland). Bacteriology Div.
K. Robinson, J. R. Saxon, and S. H. Baxter.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 225-228. 7 fig, 2 tab, 6 ref.

Descriptors: *Farm wastes, *Aerobic treatment, Aeration, Chemical oxygen demand, Salmonella, Streptococcus, Pathogenic bacteria, *Waste water treatment.
Identifiers: *Staphylococcus.

The aerobic microbial degradation of swine wastes was evaluated in field studies. Studies on the influence of diet on the composition of waste as a microbial substrate have shown the excretion of inhibitory levels of copper. Chemical analyses of some of the soluble components have made it possible to compare the rates of breakdown of these components with changes in pH and the rate of removal of Chemical Oxygen Demand. A progressive and marked fall in oxygen solubility occurs as the waste concentration increases. Suspensions of Salmonella, Streptococcus, or Staphylococcus were inoculated into aerating urine cultures; these organisms survive for periods exceeding 8 days. It is possible to produce a biologically stable effluent, occasionally with a satisfactory BOD, and a clean, odorless, residual solid. Further work is needed to show how the process of purification can be improved and more clearly understood. (Schmitt-Iowa State)

0826 - E2, E3

CROP PRODUCTION AND SOIL ANALYSES AS AFFECTED BY APPLICATIONS OF CATTLE FEEDLOT WASTE,

Southwestern Great Plains Research Center, Bushland, Tex.
A. C. Mathers, and B. A. Stewart.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 229-234. 2 tab, 6 fig, 3 ref.

Descriptors: *Farm wastes, *Grain sorghum, *Crop response, Soil tests, Leaching, Nitrates, Cattle, Feed lots, Irrigation effects.

A field study was initiated in 1968 to determine the effect of varying rates of cattle feedlot waste on crop growth, nitrate content of forage, and accumulation of nitrate, chlorides, and other constituents in the soil profile. Rates of feedlot waste were 0, 10, 30, 60, 120, and 240 T/A applied to the same plots annually. One treatment received 240 T/A the first year only. Commercial fertilizer treatments of 240-0-0 and 240-50-50 lbs/A applied annually were also included to compare to the waste treated plots. Wastes were spread and plowed under in the spring. In 1969, the plots were not irrigated prior to seeding grain sorghum, but they were in 1970. Seasonal irrigations were applied as needed to provide adequate moisture for plant growth. Soil samples were taken before the experiment was started, at seeding times, and following harvests. Samples were analyzed for nitrate, nitrite, ammonium, chlorides, and conductivity. Yield values and soil analyses concerning the first two years of the study are presented and discussed. (Schmitt-Iowa State)

0827 - B2, D4

A BARRIERED LANDSCAPE WATER RENOVATION SYSTEM FOR REMOVING PHOSPHATE AND NITROGEN FROM LIQUID FEEDLOT WASTE,

Michigan State Univ., East Lansing. Dept. of Agricultural Engineering.
A. E. Erickson, J. M. Tiedje, B. G. Ellis, and C. M. Hansen.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 232-234. 2 fig, 2 tab.

Descriptors: *Farm wastes, Nitrification, Denitrification, Nutrient removal, Feed lots, Hogs, *Waste water treatment.
Identifiers: *Barriered Landscape Water Renovation System.

A Barriered Landscape Water Renovation System (BLWRS) consists of an inexpensive impervious water barrier installed below the surface of sand soils. The barrier modifies the soil environment so that an aerobic zone and an anaerobic zone are formed in the soil. The liquid waste is spread on the aerobic zone where the organic matter is decomposed and the nitrogen compounds nitrified. The nitrate is leached into the anaerobic zone where denitrification takes place. The phosphate is removed from the system by adsorption on a phosphate adsorber and in the soil. The renovated water, low in adsorption on a phosphate adsorber and in the soil. The renovated water, low in nitrogen, phosphate, and organic matter, seeps off the edges of the barrier into the aquifer or the water can be collected and recycled. Anaerobic swine waste was spread on this barrier. The total nitrogen content of the wastewater was 440 ppm and of the effluent less than 2 ppm. The average phosphate content of the waste was 38 ppm and of the effluent 0.04 ppm of phosphate. This simple, inexpensive, and efficient way of disposal of feedlot wastewater will also protect surface and underground waters from contamination.
(Schmitt-Iowa State)

0828 - E2, F1

DISPOSAL OF BEEF MANURE BY DEEP PLOWING,

Texas A and M Univ., College Station. Dept. of Agricultural Engineering.
D. L. Reddell, W. H. Johnson, P. J. Lyerly, and P. Hobgood.
In: Livestock Waste Management and Pollution abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 235-238. 4 fig, 4 tab, 6 ref.

Descriptors: *Farm wastes, *Deep tillage, *Cost comparisons, Cattle, Crop production, Crop response, Trenches, Waste disposal.

Four tillage techniques for deep plowing large quantities of manure into the soil were evaluated at El Paso and Pecos, Texas, during the summer of 1970. The soil at El Paso is a sandy loam, with a sandy subsoil. The soil at Pecos is a silty clay loam. Up to 900 tons of manure per acre can be plowed under with a 30-inch moldboard plow at a minimum cost of 4.5 cents per ton. In sandy soils, the disk plow should be able to plow under at least 600 tons per acre with a minimum cost of 2.1 cents per ton. The 18-inch plow is limited to about 300 tons per acre. The trencher seems most versatile from the standpoint of high rates and soil penetration depths. The costs will be high and in the order of 50 cents per ton at the 900 ton level. The complete mixing of manure and soil as done by the trencher is impressive. At this time, the water quality program shows no serious pollution problem for surface water runoff. The soil water samples at the 4-foot depth indicate that denitrification is taking place. The major groundwater and soil pollution problem would appear to be from sodium chloride. (Schmitt- Iowa State)

0829 - A3, C3, C4, E2

WATER QUALITY OF RUNOFF FROM GRASSLAND APPLIED WITH LIQUID, SEMI-LIQUID, AND 'DRY' DAIRY WASTE,
Auburn Univ., Ala. Dept. of Animal and Dairy Science.
T. A. McCaskey, G. H. Rollins, and J. A. Little.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 239-242. 1 fig, 5 tab, 4 ref.

Descriptors: *Farm wastes, *Return flow, Water quality, Cattle, Odor, Biochemical oxygen demand, Agricultural runoff, *Water reuse, Waste disposal.
Identifiers: *Field-spreading.

Dairy waste was applied to runoff plots to simulate rates of application employed on Auburn University Agr. Exp. Station: (a) irrigation of waste from a holding tank; (b) spreading by a tank wagon, and (c) conventional manure spreader for applying 'dry waste'. Irrigation of liquid manure on grassland at 0.96 tons per acre (dry basis) once each 3 weeks has been practiced with commercial equipment for 21 months. There were no significant odors, flies, or manure accumulation problems at the disposal site. The application of 0.6 tons per acre once or twice during a three-week period by a tank spreader for 19 months also did not cause any problems. The application of waste by the conventional method on permanent disposal sites at rates greater than 3.2 tons/acre once each three weeks resulted in marked accumulation of manure solids. Rates exceeding those accomplished with one or two applications per three-week cycle are not advised unless a cropping system is used. The average BOD5 was 147 mg/l for runoff from grassland applied with an accumulative total of 34 tons (dry basis) per acre as irrigated waste, 45 mg/l for 22 tons/acre of semi-liquid waste, 87 mg/l for 122 tons/acre dry waste, and 17 mg/l for the control. (Schmitt-Iowa State)

0830 - C3, E2

FATE OF INORGANIC FORMS OF N AND SALT FROM LAND-DISPOSED MANURES FROM DAIRIES,
California Univ., Riverside. Dept. of Soil Science and Agricultural Engineering.
D. C. Adriano, P. F. Pratt, and S. E. Bishop.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 243-246. 1 fig, 7 tab, 8 ref.

Descriptors: *Farm wastes, *Nitrates, *Leaching, Ammonia, Denitrification, Salts, Chlorides, Cattle, Path of pollutants, Waste disposal.
Identifiers: *Field-spreading.

Because land disposal without pretreatment is the most common method of disposal of cattle wastes in Southern California, salts and nitrates in soils and groundwaters must become important factors in dairy waste management. Average nitrate-nitrogen concentrations of 92, 74, and 66 ppm in soil solutions at the 10 to 19 foot depth for corrals, pastures, and croplands, respectively were found in the Chino-Corona dairy area. These solutions will eventually reach the underlying groundwater, which at the time of sampling, had lower nitrate concentrations. Reducing the present cow population of 10 per disposal acre to about 3 per acre would keep nitrate-nitrogen levels at less than 10 ppm in soil solutions beyond the root zone, in soil profiles under croplands and pastures. Under existing conditions, manure from 20 dairy cows had about the same amount of salt as 3 acre-feet of irrigation water. Maximizing ammonia volatilization from manure before incorporation into the soil will reduce the nitrate-nitrogen pool in the soil.
(Schmitt-Iowa State)

0831 - B2, E2

EFFECT OF RATE OF POULTRY MANURE APPLICATION ON SELECTED SOIL CHEMICAL PROPERTIES,
Arkansas Univ., Fayetteville. Dept. of Agronomy.
L. H. Hileman.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 247-248, 5 fig.

Descriptors: *Farm wastes, *Poultry, *Fertilization, Crop response, Salinity, Soil properties, *Soil chemical properties, Salts.
Identifiers: *Field-spreading.

Poultry manure, especially broiler litter, is a valuable by-product of the poultry industry. Long-time use by farmers has indicated soil imbalance results from continuous heavy applications. On a dry weight basis, broiler litter contains 4.11% nitrogen, 1.45% phosphorus, and 2.18% potassium. Broiler litter containing 26% moisture was mixed into the upper 4 inches of Ruston sandy loam, Sharkey clay loam, and Captina silt loam, at rates of 5, 10, 15, and 20 tons per acre for a greenhouse study. Ky-31 Fescue was planted but did not germinate. A rapid rise in soil temperature and in pH was noted on all soils. The ammonia released may react with the soil clay exchange capacity resulting in high levels of Ca, K, and Mg ions in the soil, contributing to the soluble salt level. Soil potassium levels increased greatly. High levels of potassium combined with ammonia inhibit the germination and growth of most crop plants. Even at the 5-ton rate, severe salt toxicity was found on all three soils three months after litter incorporation. Salt problems can be determined by soil conductivity measurement. (Schmitt- Iowa State)

0832 - A4, B1, C3, C4, E2

GROUNDWATER POLLUTION DUE TO HIGH ORGANIC MANURE LOADINGS,
Rutgers - The State Univ., New Brunswick, N.J. Dept. of Environmental Sciences.
T. J. Concannon, and E. J. Genetelli.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971. p 249-253, 4 fig, 3 tab, 15 ref.

Descriptors: *Farm wastes, *Groundwater, Water pollution, Salinity, Poultry, Fertilization, Bio-indicators, Sampling, Waste disposal.
Identifiers: *Groundwater pollution.

Four specific methods of disposing of organic manures utilize soil as the ultimate disposal media. These include lagooning, sanitary landfilling, subsoil injection, and the PFC method. All these methods could cause serious pollution of ground waters due to heavy loadings of organic and inorganic materials. Contaminants studied were total organic carbon (TOC), NH4+, SO4, PO4, Cl, Na, Mg, Ca, and K. Bacteriological analyses were also performed. Four loading rates, 0, 15, 30 and 45 tons of dry poultry solids per acre were used in field plots as well as laboratory soil columns. Although TOC concentration levels were high in the field plots, no significant difference could be found between control and treatments. Nitrate concentrations exceeded USPHS limits, but the levels were not significantly different from the control. Chloride concentration did not exceed USPHS limits, sulfate concentrations slightly exceeded the limits. All fecal coliform tests were negative. Soil columns provided a controlled means for studying the soil as an effective disposal media for solid waste. (Schmitt-Iowa State)

0833 - B1, E2

EFFECT OF MANURE HANDLING SYSTEMS ON PLANT NUTRIENT CYCLING,
Wisconsin Univ., Madison. Dept. of Soil Science.
R. F. Hensler, W. H. Erhardt, and L. M. Walsh.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971. p 254-257, 6 tab, 4 fig, 7 ref.

Descriptors: *Farm wastes, *Fertilization, *Crop response, Aeration, Farm lagoons, Nutrients, Cattle.
Identifiers: Plant nutrient cycling.

Fresh, fermented (stacked), aerobic liquid and anaerobic liquid cattle manure handling systems were compared with regard to plant nutrient utilization by corn. In greenhouse studies, dry matter yields and recovery of nitrogen, phosphorus, and potassium were about the same for fresh, fermented, and anaerobic liquid systems, but were significantly less for the aerobic liquid system. Total corn yields and recovery of nitrogen and phosphorus were not greatly affected by oat straw and wood shavings bedding rates up to 8%, but at the 16% rate, yields and nitrogen recovery generally were significantly lower. Regardless of the handling method, manure increased corn yields in field studies. Yield increases were greatest for fermented and anaerobic liquid manure applied in the spring. Runoff losses of total nitrogen ranged from 3 to 24 pounds per acre annually for winter applied manure as compared to about 3 pounds per acre for non-manured soil and spring-applied manure. The concentration of nutrients in the runoff was greater from the sod compared to the fallow soils and greater for fertilizer compared to manure treatments.
(Schmitt-Iowa State)

0834 - A3, A5, B1, E2

SUBSURFACE DISPOSAL OF LIQUID MANURE,
Pennsylvania State Univ., University Park. Dept. of Soil Fertility
H. D. Bartlett, and L. F. Marriott.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 258-260, 2 tab, 3 fig.

Descriptors: *Farm wastes, *Waste disposal, Underground waste disposal, Fertilization, Waste storage, Cattle.
Identifiers: Field-spreading.

The application of animal manure below the soil surface provides a disposal method which eliminates problems of odors, flies, and runoff. Available equipment applies liquid manure four inches below the surface at approximately one gallon per square foot, a rate approaching that of surface spreading practices. The annual application of 15 tons of dairy manure per acre added approximately 700 lb. N to the soil each year. Even after allowing for estimated crop removal and various losses other than through leaching, a considerable amount of N remained in the soil. Water soluble N accounted for about 160 lb. per acre in the 4 foot profile; it was assumed some moved below that level. The optimum rate of manure application is not substantially greater than that which will supply the maximum nitrogen required by any crop, plus some allowance for losses other than leaching. (Schmitt-Iowa

0835 - D4

AEROBIC STORAGE OF POULTRY MANURE,
Greenmount Agricultural and Horticultural Coll., Muckamore (Northern Ireland).
T. A. Stewart, and R. McIlwain.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 261-262, 2 tab.

Descriptors: *Farm wastes, *Aeration, *Aerobic conditions, Waste assimilative capacity, Poultry, *Waste storage, *Oxidation lagoons.

The use of an oxidation ditch, built directly underneath a 936 bird set of California cages, to aerobically store poultry droppings has been investigated for the past two years. The 2-foot long rotor is fitted with angle-iron type blades and is driven by a 1.5 H.P. electric motor at a fixed speed of 120 r.p.m. Droppings output of the birds during the first year of operation averaged 245 lb. per day, giving a total solids loading of 59 lb., of which 71% was volatile. The BOD of the fresh droppings during this period averaged 40,850 ppm., which was a daily BOD loading on the ditch of 10.3 lb. To avoid sedimentation, it was necessary to empty the ditch when the solids content of the liquid rose above 30,000 ppm. A nutrient budget at the end of the first yearly cycle showed that 43 percent of the total solids, 56 percent of the volatile solids, 60 percent of the COD and BOD and 66 percent of the nitrogen entering the ditch were lost through bacterial activity during storage. Foaming, floating feathers, and mechanical failure of rotor bearings were the main problems encountered. Electricity consumption averaged 1 kilowatt per hour.
(Schmitt-Iowa State)

0836 - C4

SURVIVAL AND DETECTION OF LEPTOSPIRES IN AERATED BEEF CATTLE MANURE,
Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.
S. L. Diesch, B. S. Pomeroy, and E. R. Allred.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 263-266, 2 fig, 1 tab, 16 ref.

Descriptors: *Pathogenic bacteria, *Farm wastes, *Aeration, Cattle, Aerobic conditions, Waste storage, Pollutant identification, Oxidation lagoons, Public health.
Identifiers: Leptospira pomona.

Leptospira pomona, a pathogen capable of infecting both man and animals, was studied in an extended aeration method of animal manure treatment. A laboratory oxidation ditch model was developed for studying leptospires at simulated winter environmental conditions. A fluorescent antibody technique was developed and utilized for detection of leptospires. Findings indicate that pathogenic leptospires are capable of survival for up to 18 days in an aerated model oxidation ditch and 11 days in effluent and sludge. These findings do not determine the ability of leptospires isolated from a manure environment to establish infection of man and animals. There must be public concern for potential contamination of the environment and the development of health hazards because shedding of leptospires may occur for long periods of time in infected cattle. The disease is of major economic and public health importance and widespread in animal reservoirs. Treatment of sludge and effluents by chlorination or other methods is needed before discharge.
(Schmitt-Iowa State)

0837 - A5, B2, C3, C4, D4

AERATION WITH ORP CONTROL TO SUPPRESS ODORS EMITTED FROM LIQUID SWINE MANURE SYSTEMS,
Illinois Univ., Urbana. Dept. of Agricultural Engineering.
J. C. Converse, D. L. Day, J. T. Pfeffer, and B. A. Jones.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 267-271, 4 fig, 6 tab, 10 ref.

Descriptors: *Farm wastes, *Aeration, *Odor, Biodegradation, Hogs, Hydrogen sulfide, Organic acids, *Waste water treatment, Oxidation-reduction potential.

Five levels of aeration of a completely mixed liquid swine manure system were studied to determine the effect on odors produced and to study the degradation of manure under each system. Oxidation-Reduction Potential (ORP), pH, temperature, and dissolved oxygen levels of the mixed liquor were recorded daily. Analyses of the mixed liquor and off-gas were performed. The average ORP (E-cal) values for chambers 1 through 5 were +143, -212, -344, -425, -482 mv, respectively. An average D.O. of 4.68 mg/l was maintained in chamber 1 while measurable D.O. was only occasionally found in chamber 2, and never found in the remaining chambers. The total volatile acids concentration in chambers 2 and 3 was about 30 and 10 times less, respectively, than in chambers 4 and 5. The average total sulfides concentration in the mixed liquor of chambers 2 and 3 was about 22 and 3 times less, respectively, than in chamber 5. No hydrogen sulfide was found in the off-gases of chambers 1 and 2. Chambers 3, 4, and 5 had an average of 0.59, 5.78 and 21.57 mg/day as S washed from the off-gases. If the ORP in the liquid is maintained in a range from -300 mv to -340 mv and the pH is in the range from 7.7 to 8.5 the system will be relatively odorless when compared to systems undergoing anaerobic degradation.
(Schmitt-Iowa State)

0838 - C3, D4

NITROGEN TRANSFORMATION DURING AEROBIC DIGESTION AND DENITRIFICATION OF DAIRY CATTLE WASTES,
Purdue Univ., Lafayette, Ind. Dept. of Agricultural Engineering.
A. C. Chang, A. C. Dale, and J. M. Bell.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 272-274, 1 tab, 7 fig, 6 ref.

Descriptors: *Farm wastes, *Nitrification, *Denitrification, Aeration, Aerobic conditions, Cattle, Nitrogen cycle, *Waste water treatment.

Besides biodegradable material, livestock wastes also contain large amounts of plant nutrients, which cause pollution problems if they are released to the environment without control. This study investigates the fate of nitrogen during anaerobic digestion of dairy cattle wastes and seeks a possible way of removing nitrogen before final disposal. The reduction of total nitrogen was found mainly due to the volatilization of ammonia during the aerobic digestion. Temperature has a significant effect on the stability of the digested wastes. For complete denitrification of the digested dairy cattle wastes, acclimated sludge and a sufficient supply of organic carbon are needed. The amount of glucose required for complete denitrification is 150 per cent of the amount theoretically calculated. This results in a 90 per cent reduction of total nitrogen. The amount of manure slurry needed for complete denitrification of digested dairy cattle manure is an equivalent of 149 mg COD per mg of oxidized nitrogen. With a sufficient supply of organic carbon, the average rate of denitrification is 13.26 mg of nitrogen per hour. (Schmitt-Iowa State)

0839 - D4

AEROBIC BIOLOGICAL BREAKDOWN OF FARM WASTE,
Rijkszuivel Agrarische Afvalwater Dienst, Arnhem (Netherlands).
P. Ten Have.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 275-278, 1 fig, 7 tab, 1 ref.

Descriptors: *Farm wastes, *Denitrification, *Aeration, *Activated sludge, Aerobic conditions, Cattle, Hogs, Costs, Waste water treatment, Slurries.

One of the ways to reduce dung surpluses is the exposure to aerobic biological breakdown. The aim of this treatment is not only the reduction of the suspended solids in the manure, but also of the volume by producing effluents which are discharged to watercourses. When using the activated sludge process with a load of 200-300 g BOD per cubic meter per day, the effluent BOD is normally 50-100 ppm. The activated sludge settles very well (Sludge, volume index mostly below 50), so sludge levels greater than 10 Kg MLSS per cubic meter can be maintained. The result is a low sludge load of less than 30 g BOD per Kg MLSS per day. When pig slurry is treated, about 40 percent of the original solids has to be removed as surplus sludge. With urine only, breakdown reaches 75 percent. The surplus sludge must be disposed but has a smaller volume, better dewaterability, and lack of obnoxious odors. A large part of the nitrogen is lost by denitrification, with 30 percent discharged with the effluent. Biological degradation is only economically justified in The Netherlands when agricultural use is impossible within a range of more than about 10 kilometers.
(Schmitt-Iowa State)

0840 - A5, D4

LOW-VOLUME, SURFACE-LAYER, AERATION--CONDITIONED MANURE STORAGE,
Clemson Univ., S.C. Dept. of Agricultural Engineering.
C. L. Barth, and L. B. Polkowski.

Descriptors: *Farm wastes, *Aeration, *Odor, *Waste storage, Cattle, Farm lagoons, Aerobic conditions, Waste water treatment, Slurries.
Identifiers: *Surface-layer aeration.

Storage periods for wastes up to six months are necessary to maintain the quality of water resources and to complement schemes for intensified livestock production. A preliminary investigation of the procedure of low volume, surface layer aeration of stored, diluted dairy manure was made. Air was introduced into the supernatant of stored manure at various rates and depths. The supernatant of properly aerated storage units was characterized by higher oxidation-reduction potential, dissolved oxygen, and pH than poorly aerated and anaerobic storage. It also had lower volatile organic acid, ammonia, BOD, suspended solids and odor intensity. The sludge of the well-aerated unit was characterized by higher solids

concentration and a distinct surface separating the sludge and supernatant zones. Low volume, surface layer aeration effectively reduced odor production, produced a scum-free surface and a more concentrated sludge layer. Favorable storage conditions were associated with ORP greater than -50 mv (Ec), D.O. greater than 1.0 mg/l and pH greater than 8.0. An aerated depth of 20 to 24 inches was desirable. After sixty days storage, about 85% of total volume, 85% of the COD and 79% of the nitrogen was recovered.
(Schmittelowa State)

0841 - A5, B2, E2

SHORT TERM AERATION OF DAIRY CATTLE MANURE FOR IRRIGATION,

Purdue Univ., Lafayette, Ind. Dept of Agricultural Engineering.
J. R. Ogilvie, and A. C. Dale.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 283-285, 4 fig, 12 ref.

Descriptors: *Farm wastes, *Aeration, *Odor, Sprinkler irrigation, Waste storage, Cattle, Chemical oxygen demand, *Waste water treatment.

Short-term aeration reduces odors from dairy cattle wastes. This was demonstrated by use of a 2 H.P. floating aerator in a 15 foot diameter, 42 inch deep tank into which raw concrete yard manure was loaded in batch made to a maximum mixed liquor total solids content of 1.75 percent and a COD of 17,600 mg/l. Daily irrigation removed the excess liquid. The mixed liquor was odor free at all times, in the tank and on grassland. There is a conversion of soluble organics to cell material, as about 80% of the soluble COD is removed. The process requires very good mixing to prevent particles of roughage from settling. The mixing may be performed by a turbine in a baffled vessel or by a Kessener brush in a rectangular tank. Dilution of the raw manure is necessary to allow treatment but the extra two volumes of water are usually available from rainfall, washwater, or special addition. The volume of treatment facility is much reduced from the oxidation ditch. The input oxygen is the same or somewhat reduced. In cold climates, this process could be used with an additional aerated lagoon to take the winter effluent.
(Schmitt-Iowa State)

0842 - C5, D4, F2, F5

THE USE OF OXIDATION PONDS FOR POULTRY PROCESSING WASTE DISPOSAL,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Engineering.
R. L. Wesley, E. B. Hale, and H. C. Porter.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 286-287.

Descriptors: *Farm wastes, *Poultry, *Industrial wastes, Oxidation lagoons, Odor, Virginia, *Food processing industry.

Poultry processing waste is a suitable substrate for biological degradation by both aerobic and anaerobic bacteria. Several poultry processors in Virginia have faced varying stages of court litigation involving waste disposal. A team of specialists, including a biologist, an agricultural engineer, an agronomist, a sanitary engineer, a poultry processing specialist and a member of the State Water Control Board Staff were appointed by the Dean of Cooperative Extension Service at VPI to assist a processor with his problems. This group gathered the basic facts concerning the problems as follows: (a) total hydraulic load; (b) BOD 5; (c) total solids; (d) total dissolved solids; (e) D.O., and (f) fecal coliforms. These determinations were made on raw effluent, treated effluent, and on the receiving stream. A treatment system composed of a grease and grit trap, a series of lagoons and natural aeration was developed. These lagoons cover 8 acres, have a capacity of 12 million gallons, and provide a detention time of 81 days. Reductions are as follows: (a) 97% BOD removal; (b) 87% solids removal, and (c) fecal coliforms are less than 100/100 ml in the receiving stream. This treatment cost approximately $30,000.
(Schmitt-Iowa State)

0843 - D4

ACCLIMATIZATION RESPONSE TIME FOR AEROBIC WASTE DIGESTORS,

Georgia Univ., Athens. Dept. of Agricultural Engineering.
D. T. Hill, and R. E. Smith.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livertock Wastes, Ohio State University, April 19-22, 1971, p 288-290, 5 fig, 2 tab, 5 ref.

Descriptors: *Farm wastes, *Activated sludge, Anaerobic digestion, Time lag, Biochemical oxygen demand, *Waste water treatment.
Identifiers: *Acclimatization time, Time constant.

Extant circumstances for many anaerobic swine waste lagoons in present use often ensure aperiodic effluents. The output from operating anaerobic lagoons is unacceptable for receiving streams. This research was conducted to establish design criteria for an aerobic activated -sludge reactor for use with the aperiodic effluents from anaerobic lagoons. Objectives were to determine a general prediction equation for the transient operation time as a function of the off time of an aperiodically operating treatment unit and to determine the effect of a low-maintenance aeration supply on the transient operation time of the aerobic process. The use of maintenance aeration was found to have no significant effect on the value of the acclimatization time. Since there was no solids removal during the study, acclimatization time was defined as the time necessary to achieve 63.6% BOD reduction in the liquid phase, and is referred to as a time constant. The acclimatization time ranged from 5.69 to 15.21 hours between zero and infinity for values of down time.
(Schmitt-Iowa State)

0844 — E3, F2

REGULATORY ASPECTS OF RECYCLED LIVESTOCK AND POULTRY WASTES

U. S. Department of Health, Education and Welfare Division of Nutritional Sciences, Rockville, Maryland
J. C. Taylor
Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, pp. 291-292, 15 ref.

Descriptors: *Farm wastes, *regulation, *recycling, administrative agencies, legislation, poultry.
Identifiers: *Food and Drug Administration, Federal Regulations.

Section 3.59 of the code of Federal Regulations is a formal statement of policy or interpretation under Subpart A of Title 21. It states that the Food and Drug Administration has not sanctioned and does not sanction the use of poultry litter as a feedstuff for animals. Poultry litter could contain drugs and antibiotics or their metabolites and disease organisms may be transmitted to other animals by using poultry litter in animal feed. Information thought useful for FDA to consider before changing its policy include: 1) a description of the processing methods and analytical controls, 2) degree of uniformity of the product, 3) status of pathogenic organisms or their toxic metabolites, 4) levels of pesticides, drugs, heavy metals, or other substances shown safe for animal consumption, and 5) No harmful residues from drugs, pesticides or other substances or from thier metabolites, degradation products, or derivatives should occur in the edible tissues or by-products of animals consuming the product. At this time, FDA does not have enough information to modify its regulation. (Schmitt - ISU).

0845 - A9, E3

CATTLE MANURE AS FEED FOR CATTLE,

Alabama Agricultural Experiment Station, Auburn. Dept. of Animal and Dairy Sciences.
W. B. Anthony.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 293-296, 2 fig, 11 tab, 10 ref.

Descriptors: *Farm wastes, *Recycling, *Cattle, *Animal pathology, Microorganisms, Nematodes, Feed lots, Feeds.
Identifiers: *Refeeding, Wastelage.

Manure from grain-fed steers was fermented by lactic acid bacteria and about 16% of the dry matter was converted to lactic acid. This lactic acid was neutralized by anhydrous ammonia and the final product contained 45% crude protein equivalent. When blended with corn, the ammoniated manure was readily consumed by sheep. Manure blended with ground corn in the ratio 1:1.5 (w/w) was a more efficient ration for finishing slaughter cattle than a balanced ration containing corn and supplement or corn, supplement, and ground hay. All manure voided by yearling steers fed in confinement was collected and made into wastelage (57 parts manure, 43 parts ground hay). The wastelage produced daily using the excreta from one full-fed yearling steer averaged 51 pounds. A portion (6 lb.) was fed to the steer that produced the manure and the remainder (45 lb.) was fed to a beef brood cow. Cottonseed meal added to a corn-wastelage ration did not appreciably increase animal gain. Spread of infection of internal parasites and other common ailments of feedlot cattle did not occur when manure was fed over a long period to cattle and sheep. Larvae of common stomach nematodes did not develop in wastelage. (Schmitt-Iowa State)

0846 - E3, F1

NUTRITIVE VALUE OF CHICKEN MANURE FOR CATTLE,

Cornell Univ., Ithaca, N.Y. Dept. of Animal Science.
L. S. Bull, and J. T. Reid.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 297-300, 7 tab, 14 ref.

Descriptors: *Farm wastes, *Recycling, *Cattle, *Poultry, Animal pathology, Coliforms, Nutrient requirements, Costs.
Identifiers: *Air dried chicken manure.

Chicken manure, as voided, contains about 75 percent water and 4 percent nitrogen. 70 percent of the nitrogen is derived from urinary sources and 30 percent from fecal matter. More than 60 percent of the total nitrogen is in the form of uric acid, 9 to 10 percent in ammonium salts and the balance is part of the fecal material. The use of urea and ammonium salts by rumen microorganisms is well documented. Acceptability, intake, digestion, and balance trials were conducted with dairy cattle and steers to determine the value of air dried chicken manure (ADM) as a source of nitrogen, calcium, and phosphorus. The dry matter content of the ADM as fed was 81.5% and the percentages of crude protein, calcium, and phosphorus were 30.1, 7.6, and 1.2, respectively. The gross energy value was 2688 Kcal per Kg as fed. Palatability was not a serious diet problems as long as the ADM contained less than 20% moisture. ADM may be used as the sole source of supplemental N for steers and dairy cows fed low-protein basal diets. N, Ca, and P in ADM are readily available and well utilized by the animal. The economic advantages for producing ADM in large quantities are significant at current cost estimates. (Schmitt-Iowa State)

0847 - C1, D1, E3

STUDIES OF PROCESSING, NUTRITIONAL VALUE, AND PALATABILITY OF BROILER LITTER FOR RUMINANTS,

Virginia Polytechnic Inst., Blacksburg. Dept. of Animal Science.
J. P. Fontenot, K. E. Webb, B. W. Harmon, R. E. Tucker, and W. E. C. Moore.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 301-304, 5 tab, 1 fig, 16 ref.

Descriptors: *Farm wastes, *Recycling, *Poultry, Cattle, Animal pathology, Nutrients, Waste treatment.
Identifiers: Poultry litter.

A possible public health hazard exists when poultry litter is fed to ruminants. The objectives of this research were to develop a sterilizing method which will destroy pathogenic organisms in broiler litter, to determine the effect of sterilizing methods on the nutritional value of litter, to study variation in chemical composition of litter among producers and to study the palatability of cattle rations containing litter. The use of dry heat at 150 degrees C for 4 hours or longer was the only method which was consistently effective in sterilizing broiler litter. Autoclaving and the use of beta-propiolactone or ethylene oxide did not consistently affect chemical composition of litter. The use of dry heat at 100 or 150 degrees C resulted in a substantial decrease in crude protein content. There was loss of ammonia upon dry heating. In a series of nitrogen balance trials with sheep, nitrogen utilization was similar for litter autoclaved for 40 minutes, dry heated at 150 degrees C for 4 hours, or acidified to pH 6 and dry heated at 150 degrees C for 4 hours. There was considerable variation in the chemical composition of poultry litter samples obtained from different areas. No substantial amounts of pesticide residues were detected in broiler litter or in tissue from animals fed processed litter. There appears to be adaptation to acceptability of litter by cattle. (Schmitt-Iowa State)

0848 - E3

DEHYDRATED POULTRY WASTE (DPW) AS A FEEDSTUFF IN POULTRY RATIONS,

Michigan State Univ., East Lansing. Dept. of Poultry Science.
C. J. Flegal, and H. C. Zindel.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971. p 305-307. 7 tab, 9 ref.

Descriptors: *Farm wastes, *Recycling, *Poultry, Dehydration, Nutrients, Waste treatment.
Identifiers: Eggs, Dehydrated poultry wastes.

Poultry excreta, from caged layers, was collected and dehydrated. The resulting product of dehydration (DPW) was put into the diets fed growing chicks and laying hens to determine its nutritional value. The 4 week mean body weight of leghorn-type chicks was not influenced when up to 20 percent of the diet was DPW. When diets of 10 or 20 percent DPW were fed to broiler-type chicks, a significant reduction in mean body weights resulted at 4 weeks of age. Feed efficiency was inversely related to the level of DPW in the diet. In two laying experiments, involving leghorn-type laying hens, incorporation of up to 20 percent DPW did not influence egg production or feed efficiency to produce eggs. Egg quality factors were not adversely influenced by adding up to 40 percent DPW in the laying ration. Supplementation of the diets containing DPW in one experiment with calcium, phosphorus, methionine and energy had little influence on the criteria measured. The taste panel was unable to determine a difference between eggs from hens fed the control diet and eggs produced by hens fed diets containing 10, 20, and 30 percent DPW. (Schmitt-Iowa State)

0849 - E3

DRIED ANIMAL WASTE AS A PROTEIN SUPPLEMENT FOR RUMINANTS,

Michigan State Univ., East Lansing. Dept. of Animal Husbandry.
H. F. Bucholtz, H. E. Henderson, J. W. Thomas, and H. C. Zindel.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 308-310, 6 tab, 4 ref.

Descriptors: *Farm wastes, *Recycling, *Poultry, Dehydration, Nutrients, Ruminants, Proteins, Feeds.
Identifiers: Dehydrated poultry wastes.

A 134 day feeding trial utilizing nine yearling steers per group was employed in studying the value of dried poultry waste as a protein source for feed lot cattle. The ration was comprised of 80% corn silage and 20 percent shelled corn on a dry matter basis. Crude protein levels were adjusted to 12 percent of dry matter with one of the following protein supplements; dried poultry waste (DPW), 1/2 DPW - 1/2 urea, 1/2 DPW - 1/2 soybean meal, urea, and soybean meal. Average daily gain for the respective rations was: 2.75, 3.03, 2.88, 3.10, 3.35 pounds respectively. Gain differences were highly significant. Feed efficiency values were 10.43, 7.31, 8.14, 7.23, and 6.96 pounds respectively. The relatively poor performance of beef animals fed DPW may be related to the high proportion (32 percent) of product used in the ration. Digestibility and nitrogen balance values for sheep indicate that the animal manures can be successfully used as a source of energy and nitrogen in ruminant rations. From management and nutritional considerations, dehydrated animal wastes must contain more than 25 percent crude protein to economically compete with other supplemental nitrogen sources for ruminants. (Schmitt-Iowa State)

0850 - E3, F1

THE EFFECTS OF INCLUDING DRIED POULTRY WASTE IN THE FEED OF LAYING HENS,

Ministry of Agriculture, Fisheries and Food, Worcester (England). Poultry Husbandry Advisor.
B. Hodgetts.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 311-313, 9 tab, 12 ref.

Descriptors: *Farm wastes, *Recycling, *Dehydration, Poultry, Costs, Drying, Feeds.
Identifiers: Dehydrated poultry waste.

A farm trial was arranged to test the feasibility of including artificially dried poultry waste in the feed of a flock of 1800 caged laying hens. A flock of 800 birds was maintained as a control. The waste came directly from battery cages and was dried in a rotary drum type dryer. After preliminary trials it was decided to use an inclusion level of 10% dried poultry waste. After 58 weeks of lay, no real differences could be detected in terms of egg yield, mortality or egg gradings. The flock receiving dried poultry waste consumed 0.27 ounces of feed/bird/day less than the control. Body weight checks showed them to be 0.21 pounds/bird heavier at the end of the trial. The overall cost of the ration was reduced to $4.80 per ton by including dried poultry waste. This trial indicated that for the conditions prevailing it was technically, nutritionally and economically feasible to recycle poultry waste to the layers at a level of 10%. (Schmitt-Iowa State)

0851 - C1, E3

NUTRITIVE EVALUATIONS OF UNTREATED AND CHEMICALLY TREATED DAIRY CATTLE WASTES,

Agricultural Research Service, Beltsville, Md. Animal Science Research Div.
L. W. Smith, H. K. Goering, and C. H. Gordon.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 314-318, 8 tab, 5 ref.

Descriptors: *Farm wastes, *Recycling, Drying, Cattle, Sheep, Nutrients, Chemical degradation, Lignins, Cellulose, Wood wastes, *Waste water treatment.

Studies were conducted to determine the extent to which digestibility of manure plus urine and hardwood sawdust (barn waste, BW) or manure alone was increased by chemical treatments when reused as feed for sheep. Dairy cattle wastes were collected from a gutter cleaner. BW were (1) untreated or treated by adding and mixing either, (2) 3% sodium hydroxide, (3) 3% sodium peroxide, or (4) 3% sodium chlorite with the wet wastes. All were stored in plastic-sheet covered piles for 4 weeks before drying with forced hot air. The four materials were ground through a 3/8 inch hammermill screen and mixed as 83% BW, 10% cornmeal, and 7% soybean meal. These were pelleted and fed ad lib in a completely randomized experiment for 30 days. During the last 7 days, consumptions and digestibilities were measured. Dry matter digestibilities were: untreated, 23.05; sodium hydroxide, 27.32; sodium peroxide, 34.63; and sodium chlorite, 35.28. Cell wall digestibilities were: 9.67, 10.50, 17.11, and 21.92, respectively. Digestibilities of chemical treated feces were not increased to the extent observed in vitro. The less than predicted fiber digestibility may be the result of rapid passage of fecal fiber through the rumen or less than optimum treatment conditions. (Schmitt-Iowa State)

0852 - E3, E4

BIODEGRADED HEN MANURE AND ADULT HOUSE FLIES: THEIR NUTRITIONAL VALUE TO THE GROWING CHICK,

Agricultural Research Service, Beltsville, Md. Agricultural Engineering Research Div.
C. C. Calvert, N. O. Morgan, and H. J. Eby.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 319-320, 6 tab, 4 ref.

Descriptors: *Farm wastes, *Recycling, *Insects, *Larvae, Poultry, Drying, Nutrients, Feeds.
Identifiers: House flies, Musca domestica.

Initial studies demonstrated the feasibility of using the house fly larvae to biodegrade or process caged laying hen manure. Studies conducted on the comparison of processed hen manure, fresh dried hen manure, and soybean meal used these materials to constitute 22% of the diet. The materials contained 2.7, 5.2 and 8.0% total Kjeldahl nitrogen, respectively. Chicks receiving the two types of manure in the three week growth studies weighed 93 grams less than those receiving soybean meal. 22% manure does not support optimum chick growth. Newly emerged house flies contain about 69% moisture, and the dry material

is 75% protein and 7% fat. Dried ground adult house flies were diluted with cellulose to bring the protein content to 50% and this material was substituted in the chick diet of the growing chick. The total amount of fly meal in the chick diet was 22% and this was compared with 22% of 50% soybean meal. The adult house fly meal supports growth equally as well as soybean meal during the first three weeks of the growing period.
(Schmitt-Iowa State)

0853 - A9, E3

RECYCLING BROILER HOUSE LITTER ON TALL FESCUE PASTURES AT DISPOSAL RATES AND EVIDENCE OF BEEF COW HEALTH PROBLEMS,
Department of Agriculture, Watkinsville, Ga.
S. R. Wilkinson, J. A. Stuedemann, D. J. Williams, J. B. Jones, and R. N. Dawson.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 321-324, 5 tab, 3 fig, 17 ref.

Descriptors: *Farm wastes, *Fertilizers, *Crop response, Nutrients, Cattle, Fescues, Animal pathology.
Identifiers: Grass tetany, Nitrate toxicity, Lipomatosis.

Grass tetany, nitrate toxicity, and lipomatosis problems have occurred with beef grazed in tall fescue pastures heavily fertilized with broiler litter. Two Kentucky-31 fescue pasture systems were initiated in 1968 with one receiving 9.3 M.T. dry broiler house litter per acre per year, and a control receiving a maximum of 202 Kg N per ha per year from inorganic sources. These pastures were treated as ecosystems and changes in soil, plant, and animal components were evaluated. Soil from the surface 5 cm of the littered pasture had a higher percent of the exchange complex saturated with K, higher water soluble P and NO3, and a lower C/N ratio. Plant samples showed increased total N and potentially toxic levels of NO3-N accumulations during summer months in the forage. Perloline levels in fescue varied from a low in early spring and fall (160 micro g/g) to a maximum in August (830 micro g/g). Differential rates of uptake of K/Ca/Mg during early spring resulted in grass having K/Ca + Mg ratios greater than 2.2. Fat necrosis was detected by rectal palpation in 2 of 21 and 7 of 21 cows after 1 and 2 years of study in the broiler littered fescue and none in 1 of 24 in the control herd. (Schmitt- Iowa State)

0854 - E2

MOVEMENT OF POLLUTANT PHOSPHORUS IN SATURATED SOILS,
Purdue Univ., Lafayette, Ind. Dept. of Agricultural Engineering.
P. R. Goodrich, and E. J. Monke.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 325-328, 8 fig, 8 ref.

Descriptors: *Farm wastes, *Fertilizers, *Phosphorus, Nutrient removal, Phosphorus radioisotopes, Sprinkler irrigation, Leaching, Clay loam, Path of pollutants, Saturated soils.

The irrigation of animal wastes containing high concentrations of phosphate onto the soil was simulated. Two different soils and three concentrations of radioactive phosphate were used to dynamically trace the pollutant movement in saturated soil. The sandy loam with its higher clay content absorbed up to four times as much phosphate as did the sand used in this study. Soils do have a limited capacity to adsorb phosphate from solution. While this fact can be safely ignored with normal applications of phosphorus fertilizers, it must be determined and considered in the design of disposal fields for wastes where phosphorus concentrations can be quite high. The rate of absorption may be slower than implied by most literature references because the soil mass at any depth is unlikely to react quickly in total to the phosphorus influx. This was more true for the finer textured soils than for the coarser ones. Although the finer textured soils adsorbed more total phosphorus, the phosphorus front still reached depths much quicker than if the soil behind the front had been totally reactive. The linearized diffusion equation also predicted a much sharper adsorption front than was observed with the two soils tested. (Schmitt-Iowa State)

0855 - D2

TREATMENT OF LIVESTOCK-LAGOON EFFLUENT BY SOIL FILTRATION,
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
J. K. Koelliker, J. R. Miner, C. E. Beer, and T. E. Hazen.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 329-333, 2 tab, 6 fig, 5 ref.

Descriptors: *Farm wastes, *Nutrient removal, Fertilization, Sprinkler irrigation, Farm lagoons, Leaching, Phosphorus, Nitrate, *Waste water treatment, Filtration, Iowa.
Identifiers: Soil filtration, Anaerobic lagoon effluent.

In Iowa, anaerobic manure lagoon effluent can be successfully treated and disposed of between mid-April and early November by sprinkler irrigation. To minimize the possibility of runoff, the application rate should be less than half the suggested infiltration rate for clear water on the same soil. On poorly drained soils, a total application of 2 inches was the amount that could be applied at 0.40 inch per hour without runoff. Soil filtration removed from 79-93 percent of the COD, 90-97 percent of the total P, and 48-67 percent of the total-N when 14.8 to 31.4 inches of lagoon effluent were applied in one season to field plots. The total-N is the constituent that likely will limit the amount of liquid that should be applied in a season because of high nitrate-N (130-190 mg/l N) found in the tile drainage with intense applications. 600 pounds per acre of N per season is recommended. Fescue, brome, and ryegrass have grown satisfactorily where lagoon effluent was applied as long as the soil did not remain flooded. Over a three year period, measures of the chloride ion, an indication of total salt content, show approaching equilibrium, the concentration in the tile drainage about equal to that of the lagoon effluent.
(Schmitt-Iowa State)

0856 - E3

GROWTH RESPONSE OF PLANTS UNDER SPRINKLER IRRIGATION WITH DAIRY WASTE,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
A. R. Overman, C. C. Hortenstine, and J. M. Wing.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 334-337, 6 tab, 9 fig, 8 ref.

Descriptors: *Farm wastes, Sprinkler irrigation, Crop response, Fertilizers, Cattle, Nutrient removal, Leaching, Slurries.
Identifiers: Dairy wastes.

The soil-plant system was used as a sink for the nutrients in dairy waste. Manure slurry of about 0.2 percent solids was applied to plants by sprinkler irrigation at various rates to determine growth response curves. For oats the rates were 1/4, 1/2 and 1 inch per week, while sorghum received 0, 1 and 2 inches per week. Ground water samples were collected periodically and analyzed for nitrates and phosphates. Growth response of both crops is described quite well by the Mitscherlich equation, which emphasizes relative yield. Relative yields of oats were 40, 65, and 88 percent of optimum for application rates of 1/4, 1/2 and 1 inch per week respectively. Maximum yield (green weight) for oats was estimated to be 12.25 tons per hectare (5 tons/acre), while the value for sorghum-sudangrass was 90.7 tons per hectare (36.8 tons/acre). Oats grown with dairy manure measure up to those grown with inorganic fertilizer in chemical composition, palatability, and digestibility. (Schmitt-Iowa State)

0857 - D1

NITROGEN REMOVAL FROM SEWAGE WATERS BY PLANTS AND SOIL,
Maryland Univ., College Park. Dept. of Agronomy.
V. Larsen, and J. H. Axley.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 338-340, 6 tab, 17 ref.

Descriptors: *Farm wastes, *Nutrient removal, *Soil filters, Denitrification, Nitrogen compounds, Ammonia, Leaching, Sewage disposal, Filtration.
Identifiers: Soil filtration.

The addition of 3000 pounds per acre of nitrogen, 50 tons of organic matter and 200 acre inches of water per year to plants and soil was studied in reference to changes in sewage as it entered the soil and passed through the soil to a depth of 30 feet. At this depth these waters were returned to the surface by pumps. By use of chloride as a tracer, ground water dilution estimates were made and a nitrogen balance sheet for the changes, losses, and destinations of nitrogen throughout the cycle was developed. The 65 ppm of N in sewage, when applied at a rate of 508 cm per year (200 inches per year), was reduced to 11 ppm of NO3-N after the sewage has passed through 3 meters of water unsaturated soil and 6 m of water saturated soil. Denitrification and immobilization of nitrogen were the two most important factors in nitrogen removal when treatment rates were 11.7 to 23.7 cm per week. (Schmitt-Iowa State)

0858 - B2, D2, D4, E3

RENOVATION AND REUSE OF WATER FOR DILUTION AND HYDRAULIC TRANSPORT OF DAIRY CATTLE MANURE,
Massachusetts Univ., Amherst. Dept. of Food and Agricultural Engineering.
R. E. Graves, J. T. Clayton, and R. G. Light.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, 341-344, 5 fig, 3 tab, 8 ref.

Descriptors: *Farm wastes, *Slurries, *Screens, Cattle, Aeration, Recycling, Coliforms, *Water reuse, Waste treatment.
Identifiers: Bar screening.

Slurries of dairy cattle manure contain many solids which form scum mats and sludges in holding tanks and cause other problems during treatment. A stationary sloping screen with a 0.02 inch bar spacing used as a pretreatment step removed over 50% of the total solids present in manure slurries ranging from 50:1 to 2:1 (water to wet manure by weight). Two aerated treatment systems were studied, one using settled screen effluent and the other the entire screen effluent. Each system was duplicated with one using recycled effluent in the loading slurry and the other using fresh water. No adverse affects on treatment operations were attributed to recirculation. There was little difference in the effluents between systems. Concentration of salts and minerals increased in the recirculated systems which might cause problems eventually. Population of two indicator organisms did not increase in the recycled systems. Clogging and damage to pumps and nozzles in irrigating systems is reduced for the screened liquid. Storage for intermittent application requires less volume, and scum mats are eliminated from ponds by screening. (Schmitt-Iowa State)

0859 - D2

THE SEPARATION OF SOLID AND LIQUID PARTS OF PIG SLURRY,

Instituut voor Landbouwbedrijfsgebouwen, Wageningen (Netherlands).
J. C. Glerum, G. Klomp, and H. R. Poelma.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 345-347, 2 tab, 5 fig.

Descriptors: *Farm wastes, *Slurries, *Separation techniques, Sieve analysis, Sedimentation, Dewatering, Hogs, Waste treatment.
Identifiers: Centrisieve, Decanter centrifuge, Vibroscreen, Rotary vacuum filter.

Experiments designed to separate solid and liquid parts of pig slurry were made with a centrisieve, two decanter centrifuges, a rotary vacuum filter, a vibroscreen, and a sedimentation silo. With the aid of a centrisieve between 30 and 40% of the dry matter could be removed from pig slurry with a dry matter content of 5 to 8%. The separated material has a dry matter content of 14 to 19%. High demands are made on the homogenity and supply of the slurry. The material separated by the decanter centrifuge was quite dry, but the energy consumption per unit capacity was very high. The separation capacity of the vacuum filter equaled that of the decanter centrifuge but had a lower energy requirement. The separated material from the vibroscreen continued too wet and the capacity was also low. The sedimentation silo showed the biggest reduction of the slurry was initially high (15-19%) and the storage time was long. The centrisieve performed best based on results, capacity and initial expense. The sedimentation silo also performed well. (Schmitt-Iowa State)

0860 - D2

DEWATERING POULTRY MANURE BY CENTRIFUGATION,

Kentucky Univ., Lexington. Dept. of Agricultural Engineering.
I. J. Ross, J. J. Begin, and T. M. Midden.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 348-350. 2 fig, 1 tab, 4 ref.

Descriptors: *Farm wastes, *Poultry, *Dewatering, Centrifugation, Waste water treatment, Moisture content, Time, Temperature.
Identifiers: Imperforate basket type centrifuge, Manure washing.

Poultry manure is excreted at a moisture content of approximately 75 percent (wet basis) and can be dewatered by centrifugation. Tests have been conducted to determine the amount of fluid that can be removed from fresh manure in an imperforate basket type centrifuge. The variables investigated include (1) time of centrifugation - 1 to 12 minutes, (2) centrifugal force - 2000 to 10,000 g, (3) initial moisture content - 75% to 95% and (4) temperature - 40 to 120 degrees F. As much as 40% of the water can be removed from the manure at 75% moisture content and as much as 70% can be removed at 95% moisture content. Time of centrifugation in a bowl centrifuge for 1 to 12 minutes has little effect on the percentage of water removed except at low relative centrifugal forces (RCF) and high solids concentrations. Increasing the RCF significantly affects the percentage of water removed only at high solids concentrations. Increasing the temperature in the range of 40 to 160 degrees F increases the percentage of water that can be removed by centrifugation. (Schmitt-Iowa State)

0861 - D2, E3

CONCENTRATION OF PROTEINACEOUS SOLIDS FROM OXIDATION DITCH MIXED-LIQUOR,

Illinois Univ., Urbana. Dept. of Agricultural Engineering.
L. W. Holmes, D. L. Day, and J. T. Pfeffer.
In: Livestock Waste Management and Pollution Abatement, Proceedings International Symposium on Livestock Wastes, Ohio State University, April 19-22, 1971, p 351-354, 8 fig, 4 ref.

Descriptors: *Farm wastes, *Recycling, Aeration, *Centrifugation, Hogs, Nutrients, Proteins, Water reuse, Waste water treatment.

Biodegradation of swine waste in an under-the-floor oxidation ditch produces a mixed-liquor that contains minute, protein-rich particles. The 82.6 percent (dwb) portion of a swine ODML sample that passed through a 200 - mesh screen contained 75.6 percent (dwb) crude protein. Centrifuged samples of swine ODML contained a greater percentage (dwb) of crude protein and essential amino acids than corn. Centrifugation is one possible method of suspended solids concentration. The solid bowl basket-type centrifuge used in pilot plant trials was capable of concentrating the proteinaceous solids in swine ODML from an initial value of 1.2% S.S. to a desired concentration of 6 to 8 percent S.S. This represents a volume reduction of 85 percent. This removes a substantial amount of liquid that contains no measureable amino acids. COD reduction closely followed S.S. recovery values. Investigations into potential health hazards to man and animal arising from infection by pathogenic organisms in the manure will need to be conducted before this method of manure recycling may be advocated for common use. (Schmitt-Iowa State)

1000 — B1, E1

EQUIPMENT AND FACILITIES FOR MODERN METHODS OF SWINE MANURE DISPOSAL,

Oregon State University, Corvallis, Agricultural Experiment Station.
A. J. Muehling.
Reports of the Twelfth Annual Swine Day, December, 1970, p. 17-23, 8 fig.

Descriptors: *Farm wastes, *Waste disposal, *Hogs, Feed lots.
Identifiers: *Building design, Slotted Floors, Farrowing house, Construction methods, Nursery, building, Finishing building, Sow confinement, Hog production systems.

The use of slotted floors in swine housing has accelerated the use of confinement housing in hog production systems in the United States. Specific facilities which are necessary for swine production and which successfully employ the slotted floors are described. Detailed instructions for constructing the farrowing house, nursery building, and finishing building are given. Concrete slotted floors appear to endure better than wood or steel. However, manure probably is worked through expanded metal better than almost any other slotted floor material. All types of slotted floor materials are considered. The advantages of various construction materials and methods are discussed. Floor plans and pictures depict the actual building structures and give additional construction information. (Dudley - East Central)

1001 — A5, A8, C1, D4

INCLINED-PLANE TRICKLING FILTER FOR SWINE WASTE,

University of Georgia, Athens, Agricultural Engineering Department.
L. A. Mulkey, and R. E. Smith.
Presented at 1972 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 11-15, 1972, Paper No. 72-952, Order No. N172 - 952, 16 p., 2 tab., 1 fig., 14 ref.

Descriptors: *Waste treatment, *Aerobic treatment, Odor, *Trickling filters, Flow rates, *Biochemical oxygen demand, Farm wastes, *Hogs, Feed lots.
Identifiers: *Inclined plane, Contact time, Organic removal, Psychoda fly larvae, Design equations.

Operating results of an aerobic inclined plane trickling filter to treat swine wastes are reported. The results indicate that this device can be used as a component in a waste handling system. The organic removal is erratic due to Psychoda fly larvae but a definite relationship exists and the equation $s/s_0 = \exp(-0.03L/Q)$ (where s/s_0 = BOD concentration ratio, L = plane length in feet and Q = flow rate in gal/hr-ft) may be used as a design guide in waste handling systems. Contact time for wastewater and biological growth is determined by $t_0 = 17.25\ L/Q$. Odor control was found to be a desirable attribute of the system and actions of macroorgonisms could aid in the transport of organic solids across the inclined plane. (Marquard - East Central)

1002 — A5, C1, F2, F3

USING ODOR INTENSITY LIMITS IN AIR QUALITY STANDARDS,

Clemson University, Clemson, South Carolina, Department of Agricultural Engineering.
C. L. Barth.
Paper presented at 1972 Annual Meeting, American Society of Agricultural Engineers, Hot Springs, Arkansas, June 27-30, 1972, Paper No. 72-441, 3 tab., 19 ref.

Descriptors: *Air pollution, *Odor, *Regulation, Clean Air Act, *Farm wastes, Livestock, Measurement, Quality, Feed lots.
Identifiers: Intensity, Primary odor list, Syringe dilution procedure, Osometer.

Because problems with the production and control of animal agricultural odors are sure to continue, tighter regulations governing odor intensities will occur. Related difficulties are: (1) Problems in establishing a list of basic odors, (2) difficulty in measuring odor intensities and in making objective odor quality measurements, Regulations governing odor control vary greatly from state to state. Conditions and terminology for odor control need to become more uniform. The status of odor regulations for each state is given. (Dudley - East Central).

1003 — A1, B1, E1

CATTLE FEEDLOTS AND THE ENVIRONMENT,

Environmental Protection Agency, Seattle, Washington.
Cattle Feedlots and the Environment, U. S. Environmental Protection Agency, Region X, Seattle, Washington, April, 1972, 63 p., 6 tab., 35 fig., 8 ref.

Descriptors: *Feed lots, *Design criteria, *Air pollution, *Water pollution, Farm wastes, Lagoons, Runoff, Waste Disposal, Pacific Northwest U.S.
Identifiers: Waste management, Site selection, Manure mounds.

This Environmental Protection Agency booklet presents comprehensive guidelines for the control and abatement of pollution originating from cattle feedlot operations, Feedlot wastes should be considered a natural resource capable of being recycled. Proper site selection, feedlot design, and management are needed to accomplish this. Site selection is the most important factor in minimizing water pollution, Guidelines call for feedlots to be isolated from waterways and outside of a 10 year flood plain. Feedlot design should retain all wastes on the premises until ultimate disposal. This may be done by manure mounds, holding ponds, or lagoons. Land disposal is currently the only industry-wide method acceptable for ultimate disposal of feedlot wastes. (Marquard - East Central).

1004 — A5, C3

CORRELATING OIL AND ODOROUS COMPONENTS IN STORED DAIRY, MANURE,

Clemson University, Clemson, South Carolina, and University of Wisconsin, Madison.
C. L. Barth, D. T. Hill, and L. B. Polkowski.
Paper presented at 1972 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 11-15, 1972; Paper No. 72-950, Order No. M172-950, 17 p., 2 tab., 9 fig., 24 ref.

Descriptors: *Odor, *Chemical properties, Physical properties, Air pollution, Dairy industry, *Farm wastes, Cattle, Waste storage, Ammonia, Hydrogen sulfide.
Indentifiers: *Odor intensity index, Liquified waste management, Odorants, Volatile organic acid, Acetic acid, pH.

Three common odorants were identified and measured in stored dairy manure. A panel was selected to judge these odors which were present in only one of three flasks per set. The odorous flasks represented various degrees of aeration treatment. Results of the experiment showed that odorous components derived from lower aeration depths were the most difficult to distinguish. An odor intensity index (OII) was established from the experimental results. Volatile organic acid correlated best with the OII. Second best was hydrogen sulfide and poorest was ammonia. (Frantz - East Central).

1005 — A2, B1, C5, E1

FACILITY DESIGN

Wilson Company, Engineers & Architects, Salina, Kansas.
R. E. Crawofrd.
Presented at the Continuing Education Seminar: Topeka, Kansas, January 23, 1969; Hutchinson, Kansas, January 28, 1969, 14 p., 9 tab.

Descriptors: *Feed lots, *Runoff, *Water pollution control, Design, *Farm wastes, Livestock, Hydrology, Precipitation, Waste treatment, Waste storage, *Waste disposal, Irrigation.
Identifiers: *Waste management facilities.

Runoff control is an integral part of feedlot operation and cost. The principle steps are collection, storage and/or treatment and ultimate disposal. Biochemical oxygen demand, chemical oxygen demand, and dissolved oxygen data were taken to determine streamflow conditions due to feedlot runoff. Runoff variables of size of feedlot, topography', stream location, and flow and precipitation patterns were studied. At present the use of a retention system appears to be the most economical solution to preventing stream pollution from feedlot runoff. Two general plans involving holding basins of ponds are examined in detail. (Wetherill - East Central).

1006 — B1, C5

HYPOTHALAMIC TEMPERATURE REGULATION IN CATTLE,

Texas A&M University, College Station.
R. E. Stewart, and E. M. Bailey, Jr.
Paper presented at 1972 Annual Meeting, American Society of Agricultural Engineers, Hot Springs, Arkansas, June 27-30, 1972, Paper No. 72-511, 20 p., 2 tab., 10 fig., 9 ref.

Descriptors: *Cattle, *Temperature control, Humidity.
Identifiers: *Hypothalmus, *Craniotomy, Cannalae, Respiration rate. Thermal environment, Eypothalmic heating, Rectal temperature, *Lypothalmic temperature.

It was theorized that routine access to the hypothalamus by the means of in-dwelling cannulae would allow rapid testing of efficiency in control of body temperature of cattle. A semi-stereotaxic method for cannulae installation was developed. The heat loss center of two female beef calves was heated by RF energy; some degree of correlation was observed between hypothalamic temperature and respiration rate. Animals were subjected to a step change in thermal environment (75° to 95° with very high humidity); rectal and hypothalamic temperatures were found to be coupled by the respiration rate, with marked individual differences. The approach appears to have merits as a system for rapid indentification of heat tolerant breeds and individuals. (Wetherill - East Central).

1007 — B1, F1

FEEDERS SCOLDED FOR FAILING TO LEARN THEIR "MANURE ECONOMICS",

Beef, Vol. 9, No. 7, p. 43, 66, March, 1973, 1 fig.

Descriptors: *Farm wastes, *Economics, Cattle, *Feedlots, *Waste disposal, Fertilizer, Texas, Irrigation.
Identifiers: Retention ponds, Playa lakes.

In these excerpts from a speech given at U.S. Department of Agriculture Southwestern Great Plains Research Center, Bushland, Texas, feedlot operators are urged to familiarize themselves with the economics of animal wastes used as fertilizers. The approximately one ton of manure a steer produces while in the feedlot is viewed as a liability by most feeders. Manure can be an economic opportunity for the operator who takes the time and makes the effort to turn it into a marketable commodity. (Wetherill - East Central).

1008 — A1, B1, F4

ANIMAL WASTE DISPOSAL AND CONTROL OF FEEDLOT RUNOFF,

Cooperative effort of Northern Plains Branch, Soil and Water Conservation Research Division, ARS, USDA, and the departments of Agronomy and Agricultural Engineering, Nebraska Agricultural Experiment Station - Headquarters in Lincoln, Nebraska, 4 p., 29 ref.

Descriptors: Feed lots, *Waste disposal, *Runoff, *Water pollution, *Soil contamination, Farm wastes, Cattle, Odor, Groundwater, Terraces, Sedimentation, Irrigation, Water table, Nitrates, Nebraska.

Evaluation and control of soil and water pollution from cattle feedlots and studies of the factors affecting feedlot pollution potential are the objectives of research studies initiated at Lincoln, Nebraska in 1968. Emphasis is on waterborne materials, but attention is also given to air transport and odor 'problems. Terrain, water table, runoff, sedimeptation, vitrate concentrations, and climatic factors are studied at four test sites. Soil core samples confirm that flat feedlots are not major contributors to groundwater pollution. Corn fields were increased and no problems of nitrate or salt accumulations were discovered after application of runoff effluent to crops. Oxidation ditch studies have shown that, with aerobic maintenance of the ditch, odors are absent. Plans have been completed for two additional research sites. (Wetherill - East Central).

1009 — A2, C1, C5

STREAM POLLUTION FROM CATTLE FEEDLOT RUNOFF

R. K. White.
Project Completion Report No. 393X, United States Department of Interior, December, 1972, 33 p., 5 tab., 14 fig., 5 ref.

Descriptors: *Water pollution, *Cattle, *Farm wastes, *Feed lots, Runoff, Biochemical oxygen demand, Nitrogen, Water quality, Climates, Rainfall, Waste disposal, Irrigation, Ohio.

The extent to which downstream waters are polluted by animal wastes from barnlot runoff is studied. Sixty beef steers were placed in a .42 acre unpaved barnlot with a 13% southern slope. They remained there from November to May. Barnlot runoff was discharged into an intermittent waterway through an H-flume. Samples were collected in gallon bottles and kept at 4° C. Results show runoff occurs with a .5 inch rain. Biochemical oxygen demand concentration and transport were higher in winter and less in summer. Antecedent soil moisture conditions significantly affect the amounts of solids, biochemical oxygen demand, and chemical oxygen demand in the runoff, with increased amounts following dry periods. Runoff can be reduced by utilizing grassed waterways or collection ponds and irrigation. (Marquard - East Central).

1010 — A1, F4

PROCEEDINGS: LIVESTOCK WASTE MANAGEMENT RESEARCH REVIEW,

Proceedings: Livestock Waste Management Research Review, Nebraska Center for Continuing Education, Lincoln, Nebraska, 133 p., November 29-30, 1972, 2 tab., 98 ref.

Descriptors: *Livestock, *Farm wastes, *Management, *Air pollution, Water pollution, *Soil contamination, *Waste treatment, *Waste storage, *Waste disposal, Runoff, *Feed lots, *Nebraska.

This multi-disciplinary team effort revealed the objectives and priorities in fighting agricultural pollution. Specific governmental and university programs were pinpointed, outlined, and reviewed. The papers presented were, in most instances, rather general. (Frantz - East Central),

1011 — A1, F3, F4

NATIONAL LIVESTOCK WASTE MANAGEMENT PROGRAM,

Agricultural Research Service, Beltsville, Maryland, U.S. Department of Agriculture.
R. G. Yeck.

Descriptors: *Farm wastes, *Feed lots, Groundwater, Recycling, *Livestock, Air pollution, Water pollution, Soil contamination, Runoff, Waste disposal, Waste treatment, Odor, Nebraska.
Identifiers: *Livestock waste management research.

Farm waste research project areas are discussed in an overview. Some areas of research receive adequate concentration while other topics such as recycling farm wastes, are inadequately considered. Projects which need perfecting include those seeking to control feedlot runoff and odor due to land applications of farm wastes. Researchers are urged to cooperate and to work concurrently on related projects to prevent land, air, and water pollution. Recent cuts into research allocations necessitate increased teamwork. (Frantz - East Central).

1012 — F3, F4

REGIONAL LIVESTOCK WASTE MANAGEMENT PROGRAM,

R. W. Kleis.
Proceedings: Livestock Waste Management Research Review, Nebraska Center for Continuing Education, Lincoln, Nebraska, p. 11-15, November 29-30, 1972. 1 tab,

Descriptors: *Research and development, *Livestock, *Farm wastes, Management, Air pollution, Water pollution, Waste treatment, Waste storage, Waste disposal, Recycling, Nitrogen, Nutrients, Confinement pens.
Identifiers: *Soil, U.S. Department of Agriculture, Environmental Protection Agency.

Livestock waste management projects and objectives are listed for state agricultural experiment stations. The primary purpose is to enhance the total effectiveness of all participating agencies and institutions while preventing unnecessary duplication. Present efforts have been building up, as have problems of waste management, for fifteen years. Needed are projections of not only economic costs,\ but also of social and environmental costs. (Frantz - East Central).

1013 — A1, F4

POLLUTION OF AIR, WATER, AND SOIL BY LIVESTOCK,

U.S. Department of Agriculture, Lincoln, Nebraska.

L. F. Elliott.
Proceedings: Livestock Waste Management Research Review, Nebraska Center for Continuing Education, Lincoln, Nebraska, p. 23-28, November 29-30, 1972, 28 ref.

Descriptors: *Air pollution, *Water pollution, *Soil contamination, *Farm wastes, Feedlots, Odor, Surface waters, Groundwaters, Livestock.
Identifiers: Spectroscopy Chromatography, Nitrates, Oxidation, Soil profiles, Nebraska, Kansas.

Air, water, and soil pollution research projects are discussed. Air pollution studies include attempts at developing compounds which can reliably indicate odors. While surface water pollution from feedlots is no longer deemed a major problem, research has been necessary for the prevention of soil pollution and groundwater pollution at feedlot sites. Sealants in holding ponds and debris basins and management practices for land application of feedlot wastes are also being studied. (Frantz - East Central).

1014 — A2, B1, E1
APPLICATION, UTILIZATION AND DISPOSAL OF LIVESTOCK WASTE,

University of Nebraska, Lincoln, Agricultural Engineering Department.
H. Wittmus.
Proceedings: Livestock Waste Management Research Review, Nebraska Center for Continuing Education, Lincoln, Nebraska, p. 31-35, November 29-30, 1972.

Descriptors: *Waste disposal, *Waste treatment, *Farm wastes, *Livestock, Feed lots, Runoff, Irrigation, Nitrates, Nebraska, Kansas, North Dakota.
Identifiers: Mounding.

Disposal from unpaved, beef cattle feed lots has the greatest pollution potential. Separation of liquid and solid wastes is important. Separated liquids have been applied at up to 36 inches a year for two years without problems, however, long range effects of effluent application need further study. Likewise needed is the determination of the highest sustained rates at which solid wastes may be applied without soil deterioration and salinization. Mounding sometimes aids in denitrifying wastes. Other waste management systems used with varying degrees of success are: (1) drying entire waste, (2) incineration, (3) composting, (4) refeeding, (5) protein production, (6) building blocks, (7) raw material for oil, (8) methane production. Frantz-East Central).

1015 — A3, B1, C5, E2
DESIGN AND MANAGEMENT OF RUNOFF SYSTEMS,

Agricultural Research Service, Lincoln, Nebraska, U. S. Department of Agriculture.
J. A. Nienaber.
Proceedings: Livestock Waste Management Research Review, Nebraska Center for Continuing Education, Lincoln, Nebraska, p. 39-45, November 29-30, 1972, 18 ref.

Descriptors: *Farm wastes, *Feed lots, Cattle, *Runoff, Drainage, Flumes, Terracing, Nebraska.
Identifiers: *Runoff control system, Debris basin, Holding pond, Disposal area.

A runoff control system has been successfully operated on two 1000 head feedlots. Designed from the University of Nebraska Field Laboratory, the system consists of three components: debris basin, holding pond, and controlled disposal area. This system was proven superior to the one-pond system for liquid and solid wastes. Broad basin terraces may be beneficial in flood protection as well as in runoff control. Shallow debris basins are recommended for minimizing waste odors. Wooden dams with crushed rock release runoff from debris basins. The suggested disposal area is from one half up to the full size of the feedlot itself. Rainfall, slope length, and size of operation are among factors which affect runoff control design. Alternative runoff control systems and their relative costs are discussed. (Frantz - East Central).

1016 — A3, C2, C3, C5, F4
CHARACTERISTICS OF ANIMAL WASTES AND RUNOFF,

U. S. Department of Agriculture, Lincoln, Nebraska.
J. R. Ellis.
Proceedings: Livestock Waste Management Research Review, Nebraska Center for Continuing Education, Lincoln, Nebraska, p. 49-53, November 29-30, 1972, 29 ref.

Descriptors: *Conductivity, *Farm wastes, *Runoff, Thermal properties, Nutrients, Nitrates, Phosphorus, Ammonia, Pathogenic bacteria, Water pollution, *Physical Properties, *Chemical properties, *Biological properties, Animal parasites, Amino acids, Waste disposal.
Identifiers: *Pollution potential, Waste management.

Chemical, physical, and biological properties of farm wastes must be further studied to correctly determine the pollution and management problems they present. The pollution potential discharged into streams requires chemical analysis of farm wastes, while design of runoff control structures lends itself to determination of physical properties. Further research is likewise needed in assessing life of microorganisms in feces and in runoff control systems. Because comparatively little information has been established regarding the physical properties of farm wastes, further research is suggested in characterizing feces, urine, and housed feed lot wastes, especially regarding gross energy, freezing point, and thermoconductivity. (Frantz - East Central).

1017 — B1, C5, F1
WASTE MANAGEMENT AND ANIMAL PERFORMANCE,

University of Nebraska, Lincoln, Animal Science Department.
S. Farlin.
Proceedings: Livestock Waste Management Research Review, Nebraska Center for Continuing Education, Lincoln, Nebraska, p. 57-59, November 29-30, 1972, 5 ref.

Descriptors: *Feed lots, *Farm wastes, *Waste treatment, Nutrition, Nebraska, Missouri, Iowa, Minnesota.
Identifiers: *Gains, Animal performance, Mounding, Cold/warm slot housing.

Increasing animal performance, hence profits, depends upon feed lot modifications such as mounding wastes in winter and decreasing cattle density. Also, cattle with access to sheltered lots generally show increased gains, higher grade carcasses, and higher dressing percentages than cattle in open lots. Additional research may be the key to making more accurate estimates on the effects of housing and waste management on returns from feeding cattle. (Frantz - East Central).

1018 — B1, D1, E1, F1, F2
EDUCATION, ACTION AND REGULATORY PROBLEMS OF ANIMAL WASTE MANAGEMENT,

University of Nebraska, Lincoln, Department of Agricultural Engineering.
E. A. Olson.
Proceedings: Livestock Waste Management Research Review, Nebraska Center for Continuing Education, Lincoln, November 29-30, 1972, p. 63-66.

Descriptors: *Nebraska, *Economics, Oxidation lagoons, Hogs, *Waste disposal, Ventilation, Farm wastes, Odor, *Feed lots, Cattle, Hogs, Inlets (waterways).
Identifiers: *Nebraska Livestock Feeders Association, Department of Environmental Control, Voluntary waste control, Regulatory waste control, American Soil Conservation Society, Rural Economic Agricultural Programs.

Problems associated with shifting from voluntary waste control to regulations adopted by the Environment Control Council are outlined. Inspections of feed lots and investigations of existing waste management systems are in progress. Also outlined is the educational program (including economic factors coordinated by county extension agents, consulting engineers and the DEC. Advised maintenance of present systems and future research needs are discussed in outline form. (Frantz - East Central).

1019 — A1, B1, E2, F2
PROBLEMS OF ANIMAL WASTE MANAGEMENT FROM THE LIVESTOCK FEEDER VIEWPOINT,

'Chairman of the Environmental Management Committee of the Nebraska Livestock Feeders Association; Chairman of the Nebraska Feedlot Waste Control Advisory Committee.
W. Krejci.
Proceedings: Livestock Waste Management Research Review, Nebraska Center for Continuing Education, Lincoln, Nebraska, p. 69-71, November 29-30, 1972.

Descriptors: *Feed lots, *Farm wastes, *Runoff, Odor, *Cattle, *Hogs, Lagoons, Surface waters, Nebraska, Air pollution, Legal aspects.
Identifiers: *Agricultural Research Service, Department of Environmental Control.

Livestock feeders have sacrificed some of their freedom for the improvement of the environment. Arguments and recommendations are considered from the feeders' viewpoint. Filtering runoff through fields is a suggested alternative to concentration of runoff into holding ponds. Also, swine wastes should be as much in governmental focus as are cattle waste problems. More extensive data will be required to control some feed lot runoff problems, but proper management and further governmental and educational cooperation will aid feeders. (Frantz - East Central).

1020 — A1, E2, F3
POLLUTION OF AIR, WATER AND SOIL BY LIVESTOCK,

U.S. Department of Agriculture, Lincoln, Nebraska.
T. M. McCalla, and G. E. Schuman.
Proceedings: Livestock Waste Management Research Review, Nebraska Center for Continuing Education, Lincoln, Nebraska, p. 75-79, November 29-30, 1972.

Descriptors: *Air pollution, *Water pollution, *Soil contamination, *Feed lots, Odor, Runoff, *Waste storage, *Waste treatment, *Waste disposal, Livestock, *Farm wastes, Nitrates, Groundwater.
Identifiers: *Abandoned feedlot reclamation.

Although researchers have solved many problems, they have uncovered many areas which require further research. A standard method for defining odorous compounds is needed. More reliable maintenance and sealants are needed to prevent seepage into ground water. Experiments in land disposal should be carried out for at least ten years to assure long range effects. (Frantz - East Central).

1021 — A2, B1, E1, F2
APPLICATION, UTILIZATION AND DISPOSAL OF LIVESTOCK WASTES,

University of Nebraska, Lincoln, Agricultural Engineering Department.
O. E. Cross.
Proceedings: Livestock Waste Management Research Review, Nebraska Center for Continuing Education, Lincoln, Nebraska, p. 83-89, November 29-30, 1972, 14 ref.

Descriptors: *Farm wastes, Feed lots, *Waste disposal, *Recycling, *Water pollution, *Application methods, Irrigation, *Soil management, Physical properties, Chemical properties, Runoff, Groundwater, Effluents, Nitrates, Centrifugation, Conductivity, Phytotoxicity, Cattle, Hens, Turkeys.
Identifiers: Micronutrients.

Research plans for fourteen projects are given. Research objectives and problems to be faced are discussed. Current problems include waste management, waste utilization, runoff control systems, effluent disposal and effects of disposal on agricultural land. (Frantz - East Central).

1022 — A2, A5, B2, F3
RESEARCH NEEDS FOR THE DESIGN AND MANAGEMENT OF BEEF FEEDLOT RUNOFF CONTROL SYSTEMS,

Agricultural Research Service, Lincoln, Nebraska, U.S. Department of Agriculture.
N. P. Swanson.
Proceedings: Livestock Waste Management Review, Nebraska Center for Continuing Education, Lincoln, Nebraska, p. 93-97, November 29-30, 1972, 4 ref.

Descriptors: *Feed lot, *Waste disposal, Nebraska, *Farm wastes, *Pollutants, *Cattle, Gravity, Irrigation, *Runoff, Effluents, Infiltration.
Identifiers: Environmental Protection Agency, Buffer strips, Field disposal, Meat Animal Research Center, University of Nebraska Field Laboratory, Soil Conservation Service.

Current research should partially resolve feed lot runoff problems, but the goal is set for "zero pollution." New plans and objectives for overland flow, buffer strips, feed lot floor design and topographical research are discussed. These methods require researched proof of environmental acceptability. Proper distribution of effluent is of major concern to the Soil Conservation Service. Odor, because of nuisance suits, may be the greatest runoff problem. The facilities of the University Field Laboratory and Meat Animal Research Center is aiding research in several runoff control areas. (Frantz - East Central)

1023 — C1, E1
CHARACTERISTICS OF LIVESTOCK WASTE AND RUNOFF,

Agricultural Research Service, Lincoln, Nebraska, U.S. Department of Agriculture.
Proceedings: Livestock Waste Management Research Review, Nebraska Center of Continuing Education, Lincoln, Nebraska, p. 101-103, November 29-30, 1972, 29 ref.

Descriptors: *Farm wastes, *Physical properties, *Chemical properties, *Feed lots, Coliforms, Pathogenic bacteria, Lagoons, Management, *Waste disposal, Degradation, Runoff, Cattle.
Identifiers: *Catonic nutrients, Mounding, Microbial properties.

Defining physical, chemical and microbial characteristics is basic to current and future farm waste disposal and runoff control. Three projects whose aims are determining physical and chemical properties in relation to the mechanics of waste disposal are discussed. Approximately three years will be required to complete needed research in these areas. (Frantz - East Central).

1024 — B1, F4
WASTE-INDUCED PROBLEMS OF HOUSED LIVESTOCK,

U.S. Meat Animal Research Center, Agricultural Research Service, Clay Center, Nebraska, U.S. Department of Agriculture.
Proceedings: Livestock Waste Management Research Review, Nebraska Center for Continuing Education, Lincoln, Nebraska, p. 107-110, November 29-30, 1972, 1 tab,

Descriptors: *Sheep, *Cattle, *Hogs, Nebraska, Recycling, Pollutants, Odor, Waste disposal, *Confinement pens, *Feed lots, Nutrients, Oxidation, Waste treatment, Transportation.
Identifiers: *Housed confinement, Meat Animal Research Center.

Although farm waste problems are in great need of research, livestock confinement provides numerous advantages: greater mechanization of chores, animal protection, and potentially increased production. Specific problems related to waste collection, treatment, transportation and disposal are listed in order to priority; odors, nutrient or chemical control or adjustment, treatment for reduction, land disposal, re-use, and system selection. Housed livestock research facilities at Nebraska's Meat Animal Research Center are described and possible research suggestions are listed. (Frantz - East Central).

1025 — D1, E1, F3
OTHER RESEARCH NEEDS,

University of Nebraska, Department of Agricultural Engineering.
W. E. Splinter.
Proceedings: Livestock Waste Management Research Review, Nebraska Center for Continuing Education, Lincoln, Nebraska, p. 113-114, November 29-30, 1972.

Descriptors: *Farm wastes, Proteins, Runoff, *Feed lots, *Waste disposal, *Recycling, Confinement pens, Aquatic animals, Hogs, Cattle, Filters, Nebraska.
Identifiers: *Paunch manure, Horses.

While needs are being met in many research fields, several areas will require increased attention. Alternate methods of recycling cattle manure, the use of grass as a runoff filter, and the treatment and disposal of swine, horse and aquatic wastes should further be explored. (Frantz - East Central).

1026 — F3
REGIONAL ADMINISTRATOR'S SUMMARY,

Agricultural Research Service, North Central Region, Peoria, Illinois, U.S. Department of Agriculture.
T. B., Kinney, Jr.
Proceedings: Livestock Waste Management Research Review, Nebraska Center for Continuing Education, Lincoln, Nebraska, p. 117-119, November 29-30, 1972.

Descriptors: *Farm wastes, Research.

The regional administrator encourages research efficiency by increased cooperation among state, federal and industrial groups. Research priorities must be justly established and sound research must be carried out on high priority problems. (Frantz - East Central).

1027 — F3
REGIONAL ADMINISTRATOR'S SUMMARY,

Agricultural Research Service, North Central Region, Peoria, Illinois, U.S. Department of Agriculture.
H. M. Teeter.
Proceedings: Livestock Waste Management Research Review, Nebraska Center for Continuing Education, Nebraska, p. 121-124, November 29-30, 1972.

Identifiers: *Program Planning Review.

Researchers should be required to do fewer reviews and reports that could be done through the Program Planning Review. The Program Planning Review plans and evaluates research programs and assesses the quality and effectiveness of research. (Frantz - East Central).

1028 — F3
AREA DIRECTOR'S SUMMARY,

Agricultural Research Service, Clay Center, Nebraska, U.S. Department of Agriculture.
K. E. Gregory.
Proceedings: Livestock Waste Management Research Review, Nebraska Center for Continuing Education, Lincoln, Nebraska, p. 125-126, November 29-30, 1972.

Descriptors: *Farm wastes, *Management, *Feed lots.
Identifiers: *U.S. Meat Animal Research Center, Agricultural Research Service.

High priority problems call for specific research approaches. Shortage of funds necessitates consolidation of some programs and reduction of others. Resources should be budgeted for efficient research at all locations. (Frantz - East Central).

1029 — F9
CONCLUDING COMMENTS,

Agricultural Experiment Station, College of Agriculture, University of Nebraska, Lincoln.
H. W. Ottoson.
Proceedings: Livestock Waste Management Research Review, Nebraska Center for Continuing Education, Lincoln, Nebraska, p. 127-129, November 29-30, 1972.

Descriptors: *Farm wastes, Crop production, Livestock, Soils, Marketing, Waste disposal, Odor, Feed lots, Confinement pens, Nebraska.
Identifiers: *Agricultural Research Service, Environmental Protection Agency, Land application.

The livestock waste management conference was a success. The conference was a bench mark inventory on which research in livestock waste management may be planned in the future. (Frantz - East Central)

1030 — C3, E3
RECOVERY OF ANIMAL FEED FROM CATTLE MANURE,

Northern Marketing and Nutrition Research Division, Agricultural Research Service, Peoria, Illinois, U.S. Department of Agriculture.
R. W. Jones, J. H. Sloneker, and G. E. Inglett.
Proceedings 18th Annual Institute of Environmental Sciences, p. 267-269, 3 tab., 17 ref.

Descriptors: *Recycling, *Farm wastes, *Cattle, *Feed lots, Waste disposal, Amino acids, Proteins, Filtration, Centrifugation, Illinois.
Identifiers: *Fractionating.

In the United States over 10 million tons of high grade protein are produced annually in cattle manure. Separating useful feed from fecal waste has become a valuable process which lowers feed costs and aids in waste disposal. Four methods for fractionating manure to remove undesirable constituents to produce high-protein feed supplement are described. Manure may be refined to remove the residue fraction, yielding a soluble fraction and a feed fraction that contains 64% of the original nitrogen. The feed fraction is higher in amino acid content than corn or wheat. The average steer annually produces $34 to $59 worth of feed fraction. Feed savings alone could be used to properly dispose of less usable waste fractions. (Frantz - East Central).

1031 — D2, E2, F1
ELECTRIC IN-HOUSE DRYING OF POULTRY WASTE,

Cornell University, Ithaca, New York, Department of Agricultural Engineering.
D. R. Price, A. T. Sobel, and H. R. Davis.
Paper presented at the 1972 Winter Meeting of the American Society of Agricultural Engineers, Chicago, Illinois, December 11-15, 1972, Paper No. 72-806, 12 p., 3 tab., 9 fig.

Descriptors: *Poultry, Odor, Nutrients, *Recycling, *Farm wastes, Physical properties, Moisture, Fertilizers, *Waste disposal.
Identifiers: New York, *In-house drying, High-rise poultry house, Circulating fans, Exhaust fans, Drying costs.

Forced air over manure removes water continuously in a high rise poultry house designed to house 30,000 caged birds. The drying process removes one-half of the wastes' total weight and reduces odor by minimizing bacterial activity. The dried manure is spread only once a year, thus recycling nutrients through cropland. Design figures for a high-rise poultry house and operation costs for the drying system are included. (Frantz - East Central).

1032 — A1, F4

NEBRASKA IS NO. ONE,

Calf News, p. 38-39, July, 1972, vol. 10, No. 7, 8 fig.

Descriptors: *Feed lots, Cattle, *Farm wastes, Odor, Irrigation, Laboratories, Percolation, Soil analysis, Nebraska.

Facilities of the Agricultural Research Service at the University of Nebraska were observed by CALF. A well equipped laboratory was found that supplies data which a computer stores and disseminates. Field sampling sites were examined. Runoff, air and water penetration into the soil, irrigation, and cattle breeding are only a few of the studies made through use of these facilities. (Wetherill - East Central).

1033 — A3, D1, F5

NITROGEN IN INDUSTRY,

Ultimate Disposal Research Program, Advanced Waste Treatment Research Laboratory, Water Quality Office, Environmentaal Protection Agency, Cincinnati, Ohio.
J. B. Farrell,
Presented at symposium on Nitrogen in Soil and Water, Hespeler, Ontario, Canada, March 30-31, 1971, 14 p., 3 tab., 2 fig., 13 ref. (PB-213 731, N.T.I.S.).

Descriptors: *Nitrogen, *Industry, *Fertilizers, *Water pollution, Ammonia, Farm Animals, Urea, Activated carbon, Chlorination, Denitrification, Industrial wastes, Waste treatment, Air pollution.
Identifiers: Nitric acid.

The extent of water pollution from industrial and fertilizer production sources is examined. Nitrogen from industrial production represents only a portion of the nitrogen distributed to water. Nitrogen water pollution from industrial sources then is restricted to isolated point sources. Large tonnage processes produce nitrogenous effluents in gaseous forms thus causing air pollution and not water pollution. Small tonnage production, however, can lead to large quantities of nitrogen lost. Recovery is impractical because of the economies involved in separating nitrogen from the wastes. Nitrogen may be removed biologically by changing nitrogen to ammonia or nitrates, then through chlorination, ion exchange, or $FeSO_4$ reduction can remove nitrogen entirely or convert it to a gas. (Marquard - East Central).

1034 — E3

TECHNIQUES FOR THE SAMPLING AND HANDLING OF ANAEROBIC MICROBES IN WASTE FERMENTATION SYSTEMS,

University of Kentucky, Lexington, Agricultural Engineering Department, Baylor College of Medicine, Houston, Texas, Dermatology Department.
H. E. Hamilton, I. J. Ross, and S. W. Jackson.
Transactions of ASAE, Vol. 16, No. 1, p. 172-175, 1973, 9 fig., 4 ref.

Descriptors: *Autoclaves, *Farm wastes, *Poultry, Livestock, Anaerobic conditions, *Fermentation, Analytical techniques, Dilution.
Identifiers: Rumen sampling, Fermentor sampling, Test tubes, Pipetting device, Inoculation, Microbial growth, Colony counting, Chemical changes.

An equipment and technique experiment involved the fermentation of autoclaved chicken excreta with rumen microbes obtained from a fistulated steer being fed a diet containing 23% chicken manure. The equipment pictured and described was designed and constructed for improving the efficiency of preparing test tubes for enumerating microbes in the fermented samples. This equipment successfully aided in the experiments requiring rapid handling and processing of large numbers of samples. (Frantz - East Central).

1035 - B1, F4

IMPLICATIONS OF CROP-PRODUCTION TECHNOLOGY FOR ENVIRONMENTAL QUALITY,

Illinois Univ., Urbana. Dept. of Agronomy.
S. R. Aldrich, W. R. Oschwald, and J. B. Fehrenbacher.
Environmental Geology Notes, Illinois State Geological Survey, No 46, p 7-24, May 1971. 8 fig. 6 tab, ref.

Descriptors: *Agriculture, *Environment, *Farm wastes, *Crop production, Farm management.
Identifiers: *Crop-production technology, Environmental quality.

Illinois is used as a model to examine some effects of technology on the environment. The effects of selected modern crop production technologies are examined, including the use of nitrogen and phosphorus as fertilizers. Recent restrictions on the use of certain production technologies and attacks on fertilizer use have led to analysis in greater detail of the possibilities for an consequences of producing crops with less use of available technology. Return to more primitive agricultural methods, however, is regarded as unwise. The justification for using each practice and subsystem of production must be challenged to insure the least undesirable impact on the environment. The utilization of the best available crop-production technology will likely meet the needs of society with the least harm to the environment. (Wray-Chicago)

1036 - F4

AGRICULTURE: THE UNSEEN FOE IN THE WAR ON POLLUTION,

N. William Hines.
Cornell Law Review, Vol 55, p 740-760, 1970. 21 p, 111 ref.

Descriptors: *Agriculture, *Water pollution, *Pesticides, *Fertilizers, Chemicals, Farm wastes, Nitrogen compounds, Phosphorus compounds, Water pollution sources, Water pollution effects, Irrigation practices, Leaching, Confinement pens, Domestic wastes, Soil disposal fields, Waste disposal, Eutrophication, Waste assimilative capacity, Salinity, Saline soils, Salt tolerance, Sedimentation, Sediment Control, Soil conservation.

Agricultural wastes have received practically no attention in recent efforts to prevent and abate water pollution. Control of municipal and industrial wastes may be cancelled by failure to control the four major sources of agricultural pollution: animal wastes, chemicals, sediment, and salt. Pollution from animal wastes results primarily from the use of feed-lots to fatten beef. Feedlot runoff is high in oxygen demand, depleting oxygen supplies in streams; furthermore, the various nutrients in such wastes cause eutrophication. Pollution from feedlots may be controlled by treating drainage and disposing of accumulated solid wastes, although the latter solution has proved difficult. Both agricultural fertilizers and pesticides are major factors in water pollution. Fertilizer, through its chief nutrients--nitrogen and phosphorus--is also responsible for eutrophication. Moreover, use of fertilizer is virtually unregulated. Although pesticide usage is strictly regulated, present regulations are not directed towards water pollution. The potential harm of pesticides has not been thoroughly evaluated. Quantitatively, sediment is the most serious agricultural water pollutant; inefficiency of soil conservation districts is primarily responsible. Excessive salinity affects agricultural productivity. Irrigation increases the problem, and an adequate solution has been evasive. (Hart-Florida)

1037 - A1, C3

NITROGEN IN AGRICULTURE: THE PROBLEMS AND THE EFFECT ON THE ENVIRONMENT,

Edinburgh Univ. (Scotland).
Stephen Watson.
Advancement of Science, Vol 27, No 131, p 25-37, Sept 1970. 5 fig, 5 tab, 15 ref.

Descriptors: *Nitrogen, *Water pollution effects, *Land management, *Environmental effects, *Fertilizers, Ammonia, Nitrates, Ureas, Nitrogen fixation, Crop response, Nitrogen fixing bacteria, Nitrogen cycle, Legumes, Grasses, Proteins, Soil microorganisms, Sewage, Farm wastes.

About 80% of the world's human population utilizes only 20% of the world's available protein. The problem is not one of redistribution but of increasing protein supplies. World supplies of fixed N are divided into 60 million tons in animals, 1000 million in plants and 150,000 million in the soil. To this, 100 million tons are annually added by biological fixation and 10 million by industrial fixation. The production of N by soil microorganisms and the utilization of N by plants are reviewed in detail. The problem of proper pasture mixtures between grasses and legumes in combination with controlled grazing is considered and the phenomenon of increased N fertilizer application to grasslands is described. Combinations of legumes and grasses result in improved pastures and soil fertility but the process is too slow to rule out N fertilizer applications in combination with appropriate water applications. Field drying is a brittle process which may result in great protein loss unless carefully managed, particularly because of the high cost of evaporating water. The problem of water pollution due to increased N fertilizer application and intensified cattle feeding is considered in detail. Such pollution may be considerable, but will not be of the same order as that due to biological fixation, town sewage and industrial wastes. (Casey-Arizona)

1038 - A3, C3

CONCENTRATIONS OF POLLUTANTS IN AGRICULTURAL RUNOFF,

Texas Tech. Univ., Lubbock. Dept. of Civil Engineering; and Texas Tech. Univ., Lubbock. Dept. of Chemistry.
Dan M. Wells, Ellis W. Huddleston, and Robert G. Rekers.
Partially supported by FWQA. Water Resources Bulletin, Vol 7, No 1, p 124-132, Feb 1971. 9 p, 3 tab.

Descriptors: *Lakes, *Water quality, *Texas, *Farm wastes, *Water pollution sources, Runoff, Nutrients, Solutes, Nitrates, Phosphates, Herbicides, Pesticides, Playas, Overland flow.
Identifiers: Agricultural runoff.

Eighteen rural lakes in Lubbock County, Texas, were sampled on a routine basis following runoff-producing rainfall for a period of approximately eighteen months to determine whether or not runoff from intensively farmed agricultural areas contained significant concentrations of nitrates, phosphates, herbicides, or insecticides. An additional fifteen lakes lying within a triangle bounded by the cities of Plainview, Canyon, and Hereford, Texas, were sampled one time during the summer of 1969 to provide additional data regarding the nature and extent of the potential problem in an area with a different soil type and a slightly different cropping pattern. Based on results of detailed analyses of approximately two hundred samples of water collected from the lakes and an equal number of sediment samples collected from the same lakes at the same time, it appears that the concentrations of all chemical pollutants in runoff from agricultural lands in the High Plains are well below the allowable concentrations for drinking water. (Knapp-USGS)

1039 - A3, C3

NUTRIENTS IN STREAMS DRAINING WOODLAND AND FARMLAND NEAR COSHOCTON, OHIO,
Agricultural Research Service, Beltsville, Md. Soils Lab.
A. W. Taylor, W. M. Edwards, and E. C. Simpson.
Water Resources Research, Vol 7, No 1, p 81-89, February 1971. 9 p, 3 fig, 6 tab.

Descriptors: *Nutrients, *Runoff, *Forests, *Farms, *Ohio, Nitrogen, Nitrates, Phosphates, Potassium, Data collections, Water quality, Path of pollutants, Eutrophication, Appalachian Mountain Region, Farm wastes, Statistical methods, Fertilizers, Leaching, Water pollution sources.
Identifiers: Woodlands, Farm lands, Coshocton (Ohio).

Nitrogen, phosphate, and potassium concentrations were measured in streams draining woodland and farmland watersheds at Coshocton, Ohio 1966 through 1969. Temporal variations in the nutrient concentrations were much smaller than the changes in the rate of streamflow. No relationship was found between any nutrient concentration and streamflow, and no seasonal changes in concentration were detected. Nutrient losses from farmland were significantly greater than those from woodland. The nitrate-N concentration in the farm runoff was below 2 ppm except for one short period when it rose to 10 ppm. The input of nitrogen in the rain was greater than the loss in runoff from both watersheds. The average concentration of phosphate in runoff was 22 ppb (of P) from the farm and 15 ppb from the woodland. The analysis of the data shows that total nutrient losses cannot be calculated meaningfully unless both hydrologic and chemical data are available. The volume of water flow is the most important variable in this calculation. (Knapp-USGS)

1040 - D4, F5

STABILIZATION OF DAIRY WASTES BY ALGAL-BACTERIAL SYMBIOSIS IN OXIDATION PONDS,
Alexandria Univ (Egypt) High Inst of Public Health
F M El-Sharkawi, and S K Moawad
Journal of the Water Pollution Control Federation, Vol 42, No 1, p 115-125, January 1970. 4 fig, 5 tab, 17 ref

Descriptors *Dairy industry, *Oxidation lagoons, *Pilot plants, Algae, Biochemical oxygen demand, Biological treatment, Photosynthesis, Stabilization, *Waste water treatment, *Farm wastes
Identifiers *Alexandria (Egypt), Pandorina, Soluble organic solids

A pilot-plant study of BOD reduction of milk processing wastes is reported. A synthetic dairy waste of 750 mg/l BOD was fed continuously to rectangular concrete basins with sloping sides to minimize sludging. The detention period was 10 days. An influent pH of 9.8 was maintained to keep the pH at a level conducive to algal growth. Tank depth was important in maintaining balance between the algal and bacterial fractions of the system. The microflora showed plasticity in adapting to environmental variations. Pandorina constituted a major member of the flora highly adaptable to interaction with dairy wastes. Pandorina could tolerate wide temperature variations (11 deg to 32 deg C) at a constant depth of 75 cm. Other organisms were responsive to specific conditions and when the dominant groups suffered a serious setback, the subdominants flourished. Biochemical oxygen demand (BOD) reductions were 80 to 90 percent at a BOD loading rate of 220 lbs/acre/day (246 kg/dia/day). (Aguirre-Texas)

1041 - A4, C3

STATISTICAL EVALUATION OF SALINITY AND NITRATE CONTENT AND TRENDS BENEATH URBAN AND AGRICULTURAL AREA-FRESNO, CALIFORNIA,
Agricultural Research Service, Fresno, Calif. Groundwater Recharge Field Station.
Harry I. Nightingale.
Groundwater, Vol 8, No 1, p 22-28, Jan-Feb 1970. 7 p, 6 fig, 5 tab, 8 ref.

Descriptors: *Water pollution sources, *Groundwater, *California, *Nitrates, *Salinity, Water wells, Aquifers, Irrigation water, Fertilizers, Urbanization, Statistical methods, Surveys, Conductivity, Farm wastes, Regression analysis.
Identifiers: Fresno (Calif).

The salinity and nitrate content of well water for an urban zone (Fresno-Clovis, California) and the immediate surrounding irrigated agricultural zone were compared using data for 1950 through 1967. Time trends in these water chemical properties were evaluated statistically by dividing the 18-year period into three 6-year periods. Salinity of the urban zone groundwater has increased with time, whereas that of the agricultural zone has fluctuated considerably. Possible reasons for changes are discussed. The nitrate content of well water from both zones has increased with time, with water from the agricultural zone showing the greatest increase. (Knapp-USGS)

1042 - A3, C5, E2

THE PROBLEM OF AGRICULTURAL POLLUTION IN WATER TREATMENT,
Pawtucket Water Dept., R.I.
John A. McManus, and Albert A. Zaffa
Journal of the New England Water Works Association, Vol. 83, No. 4, p 311-321, Dec. 1969. 11 p, 2 tab, 2 fig.

Descriptors: *Water pollution sources, *Animal wastes, *Fertilizers, Farm wastes, Water pollution treatment, Legal aspects
Identifiers: *Pawtucket (Rhode Island).

The main concern of the Pawtucket, Rhode Island water supply system is the problem of pollution due to farmers using animal wastes for fertilizer. Due to the lack of large reservoir at the lowest end of the drainage basin feeding the treatment plant, the results of the animal wastes on the fields are severe at the point of treatment. The drainage and the seasonal usage of the water supply system are described. The pollution problem is in part attributed to one cattle company which hauled their waste material into the basin and deposited the solid and liquid wastes in great quantities. Because of the lack of dilution or detention time, high bacterial levels resulted. A schematic diagram of the water treatment plant is shown and its capabilities are described. The problem is that existing state law does not allow the prohibition of fertilizing agricultural land with animal wastes, even if such methods result in water pollution. (Grossman-Rutgers)

1043 - A1, B1

WASTES IN RELATION TO AGRICULTURE AND FORESTRY,
Agricultural Research Service, Beltsville, Md. Soil and Water Conservation Research Div.
Cecil H. Wadleigh.
Dep Agr Misc Publication No 1065, Mar 1968. 112 p, 1 fig, 4 tab, 139 ref, 4 append.

Descriptors: *Water pollution sources, *Water pollution effects, *Agriculture, *Forestry, Agricultural chemicals, Fertilizers, Pesticides, Farm wastes, Farm management, Organic wastes, Industrial wastes, Forest management, Sediment load, Microorganisms.
Identifiers: Farm and forestry wastes.

The sources and effects of wastes contributed to air, water, and soil by agricultural and forestry management practices are briefly discussed. The major waste categories considered are radioactivity, chemical air pollutants, airborne dusts, sediments, plant nutrients, inorganic chemicals, organic wastes, infectious agents, allergens, industrial and agricultural chemicals, and heat. A bibliography of 139 entries is included. Appendices discuss wastes adversely affecting agriculture and forestry, research on waste management, and problems in waste management needing more attention. (Knapp-USGS)

1044 - A3, E2

EFFECT OF VARIOUS FACTORS ON MOVEMENT OF NITRATE NITROGEN IN SOIL PROFILES AND ON TRANSFORMATIONS OF SOIL NITROGEN,
Wisconsin Univ., Madison.
R. J. Olsen.
Univ of Wisconsin, Water Resources Center, Report 1969. 79 p. OWRR B-004-Wis.

Descriptors: *Nitrification, *Soil nitrogen, *Public health, *Soil leaching, Groundwater, Soil profiles, Water table, Surface runoff, Farm wastes, Aerobic conditions, Incubation.
Identifiers: *Lake eutrophication, *Soil phosphorus, Alfalfa-bromegrass, Spring thaws, Fertilizer-nitrogen.

There is increasing evidence that agriculture is contributing to the increase in nitrate-nitrogen in streams, lakes, and domestic water supplies. High amounts of nitrate-nitrogen in water are a health hazard and contribute to lake eutrophication. Methods by which nitrogen may enter the water from agricultural sources include the leaching of nitrate-nitrogen through the soil profile to the water table and surface runoff, especially during spring thaws from manure applied to frozen soil during the winter. The data obtained from field experiments indicate that pollution of groundwater with nitrate-nitrogen can be limited by avoiding excessive rates of fertilizer nitrogen; providing a crop cover on the soil during the growing season; use of hay crops, such as alfalfa-bromegrass, in rotation with corn or other crops receiving fertilizer nitrogen; and not permitting unprotected manure to accumulate during the time of year when leaching can occur. Recovery of fertilizer nitrogen by three successive corn crops and as soil inorganic nitrogen following the last crop ranged from 72 to 88 percent. The average concentration of nitrate-nitrogen in the soil solution at the lowest profile depth sampled ranged from 14 ppm for virgin soils to 21 ppm for manure contaminated soils and to 33 ppm for cultivated soils. Rate of nitrification was directly related to the rate of manure application, presence of aerobic conditions, period of incubation, and soil phosphorus. The average recovery of nitrogen by chemical analysis of the soil receiving the higher manure rates after 37 weeks of incubation ranged from 24% for anaerobic conditions to 73 to 80 percent for the aerobic conditions. These data suggest that where animal manure is not to be used as a fertilizer, lagooning of the manure under anaerobic conditions may be an effective method of disposal with a minimum risk of water pollution. (Olsen-Univ of Wis)

1045 - A3

AGRICULTURE'S CONTRIBUTION TO THE FERTILIZATION OF CANAL LAKE,
Guelph Univ. (Ontario). Dept. of Soil Science.
F. R. Campbell, and L. R. Webber.
J Soil and Water Conserv, Vol 24, No 4, p 139-141, Aug 1969. 3 p, 2 fig, 2 tab, 9 ref.

Descriptors: *Eutrophication, *Nutrients, *Water pollution sources, *Agriculture, Nitrogen, Phosphorus, Fertilizers, Runoff, Farm wastes, Productivity, Aquatic plants.
Identifiers: *Canal Lake (Ontario).

Water quality, weed growth, and nutrient loadings of Canal Lake, Ontario were studied between May and November 1968. Relatively little nitrogen and phosphorus are contributed by the area's low-level agriculture. Precipitation contributes more nitrogen than streams. Agriculture contributes about 0.15 lb/acre, about a twentieth of the yield from an equivalent nonfertilized area. Most nitrogen probably comes from lake sediments, plants, and fixation of nitrogen in the lake. About 84% of the phosphorus probably originates in a lake upstream of Canal Lake. The agricultural yield is only about 63 lb from 30,000 acres. These contributions, of nutrients are negligible considering the total nutrients in the lake, the nutrient load of the streams and other sources of nutrients. (Knapp-USGS)

1046 - F1, F5

AN ECONOMIC ANALYSIS OF POULTRY PROCESSING WASTEWATER IN DELAWARE AND APPROPRIATE MUNICIPAL SEWER TAXATION,

Delaware Univ., Newark. Dept. of Agricultural and Food Economics.
B. L. Hudson.
M. S. Thesis, June, 1970. 92 p, 28 fig, 4 tab, 40 ref, 3 append. OWRR B-003-DEL (3).

Descriptors: *Waste water (Pollution), *Economics, *Waste water treatment, *Poultry, *Water pollution sources, Biochemical oxygen demand, Industries, Delaware, Sewage districts, Taxes.
Identifiers: *Sewage assessments.

One important characteristic of the poultry processing industry is its high water usage rate. This characteristic has become cause for great concern among processors due to the newer and more rigid water pollution regulations of both the federal and state governments. Five of Delaware's six poultry processing plants were studied primarily to determine the sources of waste and wastewater. The general study procedure involved isolating and analyzing effluents from individual in-plant operations. The scalding, dressing, eviscerating, and chilling operations are the main sources of wastewater. The clean-up operation also produces sizable amounts of wastewater although precise measurements were unavailable. Average main effluent volumes per processed bird varied considerably between plants, ranging from 3.2 to 8.2 gallons. A case study of Milford, Delaware's wastewater treatment operations indicated that sewage assessments may take the form of (1) annual contributions by firms to the municipality, (2) cost-sharing payments for construction and maintenance, and (3) payments based on variable rates. Equity and efficiency considerations suggest, however, that a combination property-marginal cost tax system might be more desirable. (Settle-Wisconsin)

1048 - B2, D4, E2

SPRINKLER APPLICATION OF ANAEROBICALLY TREATED SWINE WASTES AS LIMITED BY NITROGEN CONCENTRATION,

Iowa State Univ., Ames. Dept. of Agricultural Engineering.
J. K. Koelliker.
Ph.D. Thesis, 1972. 203 p, 11 fig, 66 tab, 60 ref, 16 append. OWRR A-021-IA (6).

Descriptors: *Anaerobic conditions, Irrigation, *Chemical oxygen demand, Denitrification, *Nitrogen, Application rates, Phosphorus, Lagoons, *Farm wastes, *Wastewater treatment, *Water reuse, *Sprinkler irrigation, Soils, Hogs, Wastewater disposal, Sands, Clays.
Identifiers: *Swine wastes.

The effectiveness of soil as a final treatment and disposal system for anaerobically treated swine wastes was examined. Anaerobic lagoon effluent was applied to grass covered and tile drained field by sprinkler irrigation during the May-October season. Over a 3-year period, average concentrations in the tile drainage were 5-21 percent of the COD, 20-40 percent of the nitrogen and 1-10 percent of the phosphorus applied in the anaerobic lagoon effluent. In 4-ft. laboratory soil columns with soils ranging in texture from sand to silty clay loam, less than 10 percent, on a mass basis, of the nitrogen added in anaerobic lagoon effluent was lost; unless the soil became so waterlogged that at some time during a 45-wk. period it would no longer infiltrate the 2 inches/wk. applied. Addition of 20 tons/acre of oats straw as an energy source to the top six inches of half the columns did not improve nitrogen losses. All textures of soils removed more than 95 and 99.8 percent of the COD and phosphorus, respectively, from the percolate. Soil has a great potential to remove oxygen-demanding material (COD) and phosphorus from anaerobic lagoon effluent; however, its effectiveness as a final treatment system is limited by an inability to successfully remove nitrogen. Therefore, anaerobic lagoon effluent should be considered as a very dilute solution of liquid nitrogen and its application to soil restricted to rates that are consistent with the nitrogen requirements of crops grown on the disposal area. (Powell-Iowa State)

1049 - A3, F1

ECONOMICS OF WATER QUALITY MANAGEMENT: EXEMPLIFIED BY SPECIFIED POLLUTANTS IN AGRICULTURAL RUNOFF,

Iowa State Univ., Ames.
J. J. Jacobs.
Ph.D. Thesis, 1972. 208 p, 5 fig, 58 tab, 129 ref, 2 append. OWRR B-015-IA (2).

Descriptors: Economics, Water quality control, Pollutants, *Agricultural runoff, *Sediments, *Phosphorus, Iowa, *Water management (Applied), Water pollution sources, *Cost analysis, Cultivation.
Identifiers: *Nishnabotna River Basin, Minimum tillage.

The role of economics in environmental quality management was analyzed, with particular reference to the optimal level of water quality in a selected use area. Sediment and phosphorus in agricultural runoff were the pollutants selected in depicting the role of economics in water quality management. The agricultural land in the Nishnabotna River Basin in Southwestern Iowa was the study area. This land was split up according to six capability classes, supplied by the Conservation Needs Inventory. These capability classes in combination with crop rotations, tillage methods and conservation practices are regarded as a cropping system. For each system the annual costs and returns in addition to sediment and phosphorus losses were estimated. With this information the minimum cost of achieving specified levels of water quality, i.e., sediment and phosphorus, were obtained. The study results point up the dominance of minimum tillage and continuous row crops in the optimal solutions. The results also indicate that the magnitude of the delivery ratio and the phosphorus constraints have a relatively small impact on the cost of the program. Furthermore, it was shown that the most stringent constraint could be met at an estimated cost of about $4.75 per acre with a delivery ratio of .25. While this cost does not appear to be unreasonable, comparing the control cost with the benefits to a municipal use indicates that this level of quality control can only be justified economically if there is a large reuse of the water (80-400:1) or substantial aesthetic benefits. (Powell-Iowa State)

1050 - A1, F2

THE LEGAL FUTURE: NEW THEORIES OF ENVIRONMENTAL PROTECTION,

California Univ., Berkeley.
P. S. Berry.
In: Transcripts of the Speeches, National Conference on Environmental Law, p 183-207, November 1970. 25 p.

Descriptors: *Environmental sanitation, *Remedies, *Legislation, *Pollution abatement, Natural resources, Resource allocation, Environmental effects, Conservation, Water pollution, Water pollution control, Air pollution, Federal government, State governments, Administrative agencies, Government finance, Industries, Forest management, Oil industry, Livestock, Mining, Lumbering, Land management, Taxes, Decision making, Legal aspects.
Identifiers: National Environmental Protection Act.

Historical approaches to conserving natural resources through statutory and common law means provide solely remedial measures. Recent trends in tort law evidence stronger methods of environmental protection. This has been achieved by broadening the concept of causation and imaginative applications of the public trust doctrine. Comprehensive protection of the environment may result from either a constitutional amendment creating a new civil liberty or stronger state statutes. The 1970 Michigan Environmental Protection Act is discussed, with emphasis upon what this new legislation will accomplish. The National Environmental Policy Act is criticized for its failure to prohibit ecologically unsound activities. The concept of corporate responsibility for private industry is discussed, and the traditional polarity between the private profit motive and national environmental preservation is considered. Environmental solutions must alter the basic nature of private industry. Possible means of attaining this include: (1) national law, (2) state law, and (3) voluntary charter amendment. Proposals are suggested for revising taxation objectives. The Public Land Law Review Commission's Report is criticized, and alternatives to its findings are proposed. (Ross-Florida)

1051 - A2, B2, C5

POLLUTION POTENTIAL OF SALMONID FISH HATCHERIES,

Washington Univ., Seattle. Water and Air Resources Div.

Water and Sewage Works, Vol. 117, No. 18, p 291-297, August 1970. 6 fig, 3 tab, 15 ref.

Descriptors: *Fish hatcheries, *Salmonids, *Water pollution sources, *Biochemical oxygen demand, *Dissolved oxygen, *Hydrogen ion concentration, *Ammonia, *Nitrates, *Phosphates, *Solid wastes, *Animal wastes (Wildlife), Water pollution control, Food abundance, Chemical oxygen demand, Pathogenic bacteria, Animal parasites, Silts.
Identifiers: *Feces, Drugs.

The water pollution potential of salmonid hatchery operations was studied by surveying the literature, by questionnaire surveys, and by field tests. The study began in February 1969, and ended in February 1970. Pollution problems reported to be associated with fish hatchery operations included nutritional enrichment, algae and weed growth, taste and odor, settleable solids, pathogenic bacteria and parasites organic matter, chemicals and drugs. The literature review produced no positive results. The questionnaire survey revealed that 13 of 46 hatcheries responding indicated that they have had pollution problems. Field tests were conducted at the Green River Salmon Hatchery and the Kowlitz Trout Hatchery in the state of Washington to determine COD, BOD, and DO, pH, ammonia, nitrate, phosphate, suspended solids, dissolved solids, settleable solids, total solids, and total volatile solids. It was determined that the greatest pollution occurred during pond cleanout, and the most prevalent pollutants were fish fecal wastes and residual food. The result of the discharge of these pollutants was that: (1) the dissolved oxygen level was lowered in the effluent, (2) nutrient pollutants (Nitrate and phosphate) resulting from decomposition of fish food were increased, (3) solid pollutants both dissolved and settleable were significantly increased. It was further found that there were relationships between pollutant production rates, feeding rates, fish size, loading densities, and water supply rates. (Little-Battelle)

1052 - A3, A4, B1, E2

EFFECT OF ANIMAL WASTES APPLIED TO SOILS ON SURFACE AND GROUND WATER SYSTEMS,

Maine Univ., Orono. Dept. of Soil Sciences.
F. E. Hutchinson, R. A. Hoffman, and R. F. Jeffrey. Maine Water Resources Research Center, Orono, Project Completion Report, September 1972. 38 p, 8 fig, 21 tab. OWRR A-020-ME (1).

Descriptors: *Water pollution sources, *Groundwater, *Farm wastes, *Nitrogen, *Maine, On-site investigations, Analytical techniques, Poultry, Path of pollutants, Soil properties, Rates of application, Infiltration rates, Data collections.
Identifiers: *Poultry manure.

This research project was conducted in Maine to determine the maximum acceptable rates of application of manure in: (1) excessively drained glacial outwash, (2) well drained glacial till and (3) poorly drained Maine soils, using field plots and a lysimeter study. Periodic analyses of soil, soil water and groundwater samples from a Windsor loamy sand treated annually for two years with poultry manure at nitrogen rates up to 1400 pounds per acre. Results indicate that mineralization of N occurred rapidly and that nitrate content of the subsoil just above the groundwater became high at times at rates above 350 pounds of nitrogen per acre. Nitrogen did not move downslope in any form at the top of the fragipan in a Charlton fine sandy loam beyond a distance of 20 feet on a 10 percent slope below plots treated with rates of N up to 1400 pounds per acre for two consecutive years. When nitrogen in poultry manure was applied to a poorly drained Scantic silt loam, an unacceptable amount of nitrate N moved through the profile into the free water table from applications greater than 200 pounds of N per acre. (Woodard-USGS)

1053 - C4

BACTERIOLOGICAL WATER QUALITY ANALYSES OF METHODS FOR DETECTING FECAL POLLUTION,

South Dakota State Univ., Brookings.
Paul R. Middaugh. Completion Report April, 1970. 14 p. OWRR Project A-019-S DAK (1).

Descriptors: Water pollution sources, *Farm wastes, Bacteria E coli, Coliforms, Pathogenic bacteria, *Sewage bacteria, E coli, Enteric bacteria, Streptococcus bovis, Streptococcus faecais, *Pollutant identification.

The initial or laboratory research phase of objectives were achieved. These were to improve the specificity, speed and reliability to bacteriological methods for determinging kinds and number of fecal bacteria in water resources. The major objective of distinguishing between human and animal sources of pollution was partially achieved by improved isolation of the rumen organism Streptococcus bovis. The objective of determining the survival of selected fecal coliform and fecal streptococcus in river water with and without filtration was completed in the M.S. Thesis study by Joseph Zerfas. He compared river water in laboratory flasks with environmental river exposure chambers to determine survival effect of temperature from 10 to 30C, decreased both coliform and streptococci equally with increased temperature. Added organic nitrogen fertilization of river from normal level 2.5 ppm N to 10 to 30 ppm N stimulated growth and lengthened survival time. Both kinds of organisms increased in survival in water with reduced dissolved oxygen compared to aerated water. In untreated river water fecal coliform bacteria lived longer than fecal streptococci, 7% and 0.1% survival respectively after 7 days. Water membrane filtered to remove protozoa gave 20% coliform and 100% streptococcus survival after 7 days. In M.S. Thesis study by L. Koupal, methods for detecting the rumen organism Streptococcus bovis resulted in a rapid, sensitive selective method using membrane filter for quantitative recovery from river water and selective medium incubated in 25% CO2+75% N2 gas grows S. bovis which is then detected by starch agar overlay. Only ruminants have S. bovis in numbers in feces so S. bovis in river survival studies was proven to be a useful tracer for ruminant pollution of surface waters. More rapid and sensitive methods for both indicator and pathogenic bacteria were being investigated when the project was terminated.

1054 - A2, B1, D4

APPLICATION OF SEWAGE TREATMENT TECHNIQUES TO FEEDLOT RUNOFF,

Nebraska Univ., Lincoln. Dept. of Civil Engineering.
T. McGhee, and R. L. Torrens.
Paper presented at the 16th Annual Great Plains Waste Water Design Conference, Omaha, Nebraska, March 28, 1972. 18 p, 4 fig, 5 tab, 13 ref. OWRR-A-022-NEB (1).

Descriptors: *Biological treatment, *Farm wastes, Feed lots, Cattle, *Waste water treatment, Biochemical oxygen demand, *Agricultural runoff, *Chemical oxygen demand, *Sewage treatment, *Aerobic treatment.

Laboratory studies of the aerobic treatment of feedlot runoff were conducted to determine the effect of such handling upon waste characteristics and the design parameters required for such treatment. Liquid retention times (organic loading rate) and biological solids concentrations were varied. Studies of the application of the BOD test to this waste were also conducted. Liquid retention times in the laboratory system varied from one to eight days. The conclusions were: (1) An aerobic system can effectively treat this waste with COD reductions of 60 percent or more. (2) Retention times of three days or more are adequate to insure treatment of solids concentrations (MLSS) of 2000 mg/L. (3) The color of the runoff is affected only slightly by such treatment. (4) COD analysis is superior to BOD analysis in measuring the strength of this waste.

1055 - A2, A4

ANNUAL REPORT OF ACTIVITIES DURING FISCAL YEAR 1971.

Maine Univ., Bangor. Water Resources Center.
Annual Report No 7, 1971. 18 p, 3 append. OWRR A-999-ME (7).

Descriptors: *Water resources, *Water users, *Planning, *Projects, Legal aspects, Bottom sediments, Geochemistry, Hydrology, Coniferous forests, Rivers, Lakes, Biochemical oxygen demand, Dissolved oxygen, Management, Livestock wastes, Water quality, Education, Eutrophication, Phosphates, Water pollution control, Chlorinated hydrocarbon pesticides, Model studies, Tubificids, Physicochemical properties, Gases, Political aspects, Attitudes, Environment.

The research program conducted under the auspices of the University of Maine's Water Resources Center to solve Maine's water problems are described. Twelve projects explored the following areas: Hydrologic relationships in a coniferous forest; An investigation of the causes, effects, and control of eutrophication in Maine lakes; Phosphate retention by lake sediments; Geochemical cycles involving flora, lake water, and bottom sediments; Legal aspects of water pollution control through implementation of the effluent charge concept; Effect of animal wastes applied to soils on surface and ground water systems; The effects of DDT and other chlorinated hydrocarbons on the growth of euryhaline microalgae; Phase III--Study of a river system as a chemical reactor; Effects of burrowing tubificid worms on the exchange of phosphorus between lake sediments and overlying water; A study of the physico-chemical parameters affecting the removal of colloidal particles from water by porous media; Dissolved pollution product gases in natural waters; and Political and environmental attitudes of voters and public officials related to alternative levels of water quality and correlated alternative systems of management of the Penobscot River. The Center's researchers extend their findings to users in an active coordination, information, education, and training program. (Auen-Wisconsin)

1056 - F1

AN ANALYSIS OF THE ECONOMIC IMPLICATIONS OF THE PERMIT SYSTEM OF WATER ALLOCATION,

Iowa State Water Resources Research Inst., Ames.
N. E. Hart, R. A. Baldwin, and D. W. Hubly.
Iowa Water Resources Research Institute, Ames, Completion Report ISWRRI-43, November 1971. 261 p, 7 fig, 27 tab, 122 ref, 8 append. OWRR B-009-IA (2).

Descriptors: *Permit system, Economic efficiency, Water quality, Water resource investment, *Iowa, *Model studies, *Cost analysis, *Water allocation (Policy), Competing uses, Legal aspects, *Linear programming, Cost allocation, Evaluation.

The study contains three parts. In Part I, the literature of water allocation is reviewed and the permit system of administrative allocation is analyzed in terms of rational guidelines for allocating water as a scarce resource among competing alternatives. Special attention was given to the Iowa permit system, with the conclusion that the system acknowledges only two consistently identified points on a water user's production function (1) the point of zero output and zero water use, and (2) the point of maximum total product where the marginal physical product becomes zero. The system guidelines are insufficient for allocating water on efficiency bases if supply is limited and maximum physical productivity from water as a variable input is unattainable. In an effort to generate information about water productivities, to the end that additional points on the production function might be identified administratively as permits are granted under conditions of limited water supply in a particular area, a general model is constructed in Part II using a linear programming approach to resource allocation within an identified hydrologic area. In Part III, the general model was extended and refined to include detailed water quality considerations using both linear programming and simulation. The resulting Tandem Program Systems (TPS) Model makes possible cost adjustments in producing activities based upon the character of the wastes produced thereby, the assimilative nature of the stream and the treatment costs for maintaining a pre-determined level of water quality in the stream. Data from both the general model and the TPS model are presented. (Powell-Iowa State)

1057 - A2

EFFECTS OF POLLUTION, ESPECIALLY FROM FEEDLOTS, ON FISHES IN THE UPPER NEOSHO RIVER BASIN,

Kansas State Univ., Manhattan. Water Resources Research Inst.
F. B. Cross, and L. M. Cavin.
Completion Report 1971; 50 p, 6 fig, 7 tab, 16 ref. OWRR A-026-KAN (1).

Descriptors: *Fishkill, *Water pollution effects, Sampling, Habitats.
Identifiers: *Feedlot pollution, *Upper Neosho River Basin, Nocomis asper, Notropis rubellus, Noturus nocturnus, Notorus placidus, Notropis lutrensis, Notropis camurus.

In spring, summer, and early autumn, 1969 and 1970, a total of 49 collections of fish were made at 17 localities in the upper Neosho River Basin: Fifty-three species were recorded, approximately as many as were known from the same area prior to severe drought in the early 1950's, establishment of three mainstream impoundments in the 1960's, and severe pollution from feedlots in 1966-67. Species lists were not identical to those obtained in similar but less intensive surveys in 1952 and 1967. Changes in species composition are attributable partly to effects of impoundment (including introductions of some species) and partly to organic enrichment. Diversity indices are being determined for each collection, allowing comparisons among samples from the same site on different dates, between years, and among localities throughout the area. Three species known to have occupied these streams in the 1950's were not found in 1969 or 1970: the recently-described redspot chub, Nocomis asper, Lachner and Jenkins, 1971; the rosyface shiner, Notropis rubellus; and the freckled madtom, Noturus nocturnus. Several additional species were found only rarely in 1969-70, including the Neosho madtom, Noturus placidus, the only species endemic to the Neosho basin. These four and others affected adversely are characteristic of clear, well-oxygenated streams having clean gravel riffles; their depletion is most logically attributable to effects of pollution. The two species selected for detailed study, with respect to differential trends in their populations associated with the period of organic pollution, were the red shiner, Notropis lutrensis, and the bluntface shiner, Notropis camurus. The red shiner became more abundant and more widespread within the streams studied, following fish-kills in 1966-67. Its increase seemingly occurred at the expense of the bluntface shiner, its nearest relative in the Neosho fauna. Apart from the advantage of comparing closely-related species, the bluntface shiner was chosen as the 'pollution intolerant' form because other species fitting that description were not obtained in numbers adequate for the kinds of comparisons desired. The comparative study involved habitats occupied and relative abundance; population structure and growth rates; reproductive requirements, fecundity, and spawning period; and response to reduced oxygen concentrations (routine metabolism, behavior under oxygen stress, loss of equilibrium, and capacity for recovery from temporary stress).

1058 - A2, A4, C3, E2

DEVELOPMENT OF A MATHEMATICAL MODEL TO PREDICT THE ROLE OF SURFACE RUNOFF AND GROUNDWATER FLOW IN OVERFERTILIZATION OF SURFACE WATERS,

Minnesota Univ., Minneapolis. Water Resources Research Center.
Jack D. Johnson, and C. P. Straub.
Minnesota Water Resources Research Center, Minneapolis, WRRC Bulletin 35, June, 1971, 176 p, 58 fig, 65 tab, 78 ref, 4 append. OWRR Project B-012-MINN (1).

Descriptors: *Mathematical models, *Watersheds (Basins), *Nutrients, Nitrogen, Phosphorus, Streamflow, Sewage treatment, Effluents, Annual wastes, Fertilizers, Precipitation (Atmospheric), Soils, Water pollution sources, Model studies, Minnesota, Snowmelt, Treatment facilities, Nitrogen fixation, Denitrification.
Identifiers: *Manure spreading, *Spring runoff, Depletion processes, Nitrogen transformation, Agricultural practices, Feedlot drainage, New Prague (Minn).

A nutrient enrichment accounting mathematical model was devised for the New Prague watershed in Minnesota. The New Prague watershed is 23.3 square miles in area and is predominately a rural watershed. Model input data was collected over a 2 1/2-year period from a stream gaging station and two automatic sampling stations. Over 800 water samples were analyzed. Extensive effort was placed on better understanding the nitrogen and phosphorus cycles. It is evident that the spring runoff process and accumulative winter fertilizer applications constitute the major portion of diffuse sources of nutrients in the watershed. Point sources from feedlots and municipal and industrial effluents contribute only 11 percent of the sigma N (total nitrogen, four components) and 7 percent TP (total phosphorus). Disperse sources accounted for 89 percent of sigma N and 93 percent of TP, with spring runoff in the two months of March and April accounting for 79 percent of the annual sigma N and 64 percent of the TP. The nutrient output from the watershed could be decreased by increasing penetration of the large amounts of sigma N and TP in snowpacks into the soil through land terracing to retart rapid spring runoffs and sub-surface drains to allow rapid drainage during the crop season.

1059 - A2, A3, A4, C3

NITRATE ACCUMULATION IN KANSAS GROUNDWATER,

Kansas Water Resources Research Inst., Manhattan.
Larry S. Murphy, and Jay W. Gosch. Project Completion Report. March 1970. 56 p, 13 tab, 19 fig, 38 ref. OWRR Project A-016-KAN.

Descriptors: *Nitrates, *Groundwater, Fertilization, Irrigation, Nitrogen, Farm wastes, Fertilizers, Ammonium compounds, Water pollution sources.
Identifiers: *Nitrate movement, Feedlots.

A study of nitrate-nitrogen accumulation in soils underlying feedlots in Kansas revealed accumulations of as high as 5000 kg/ha in a 4 meter soil profile. Age of the feedlots was found to be directly related to the amount of nitrate-nitrogen which had accumulated in the soil. Vertical movement of nitrate-nitrogen in feedlot soils had occurred even in areas of low rainfall (40-45 cm per annum). Large accumulations of ammonium-nitrogen but no nitrate-nitrogen were noted in a feedlot soil with a very low cation exchange capacity. Analyses of groundwater at that location were inconclusive in relating lack of nitrate-nitrogen in the soil profile with higher levels of nitrate-nitrogen in shallow aquifers. An investigation of the effects of high rates of applied inorganic nitrogen on nitrate-nitrogen accumulations in soil and groundwater was conducted a/t two locations. Downward movement of nitrate-nitrogen under irrigated conditions was detected by deep soil sampling (5-6 meters) and comparisons of nitrate-nitrogen concentration peaks in the soil profile. Much variation in the amount of nitrate-nitrogen in the soil profile was noted even with uniform rates of nitrogen application. Investigation of nitrate-nitrogen accumulation in groundwater by means of check wells in the areas receiving large amounts of inorganic nitrogen revealed large fluctuations in the nitrate-nitrogen content over the life of the study but did not produce indications of definite trends. (McKenna-Kansas)

1060 - A2, F2

FOULING OF WATERS A MISDEMEANOR.

North Dakota Century Code Ann secs 61-01-12 thru 61-01-14 as amended (Supp 1969).

Descriptors: *North Dakota, *Water pollution sources, *Water pollution control, *Waste disposal, Water quality, Water quality control, Wastes, Industrial wastes, Refuse, Sewage effluents, Gasoline, Oil wastes, Farm wastes, Cattle, Sheep, Hogs, Sewage disposal, Streams, Rivers, Public health, Administrative agencies.

Section 61-01-12 provides that the fouling of public waters by depositing gas tars or other refuse from any gas house into streams, rivers or sewers that empty into public waters is a misdemeanor. Section 61-01-13 provides the fouling of public waters with dead animals, offal, or other refuse by depositing same on the banks or in any lake or stream within the jurisdiction of the state is a misdemeanor punishable by a fine of from $20 to $100. Section 61-01-14 provides that section 61-01-13 shall be construed to include: (1) privies and privy vaults; (2) any stable, shed, pen, yard, or corral where farm animals are located within sixty feet of the top of any lake or stream; and (3) any slaughterhouse, graveyard or cemetery within eighty feet of these waters. However, in an emergency, these provisions do not prevent any municipality from dumping untreated sewage into these waters provided they are not determined detrimental to public health. (Ross-Florida)

1061 - B1, F2

RULES FOR CONFINED FEEDING OPERATIONS WASTE WATER DISPOSAL.

Iowa Water Pollution Control Commission, Des Moines.

1969. 3 p.

Descriptors: *Iowa, *Farm wastes, *Livestock, *Confinement pens, *Water pollution sources, Cattle, Treatment facilities, Water pollution, Waste disposal, Waste water treatment, Water pollution control, Regulation, Permits, State governments, Administrative agencies, Legislation, Legal aspects, Poultry, Organic wastes, Adoption of practices, Waste water disposal.

Confined feeding operations for livestock and poultry in which potential pollution may exist and be subject to regulation are defined as a cattle feedlot or several cattle enclosures on a single property containing at least one hundred cattle and an animal population of greater than one animal for each six hundred square feet. Registration of the operation is required where one or more of the following conditions exist: (1) the number of cattle confined exceeds a thousand head, (2) the feedlot contributes to a watercourse draining a specified acreage of land above the lot, and (3) the runoff water from a feedlot flows into a buried conduit or well. Persons engaged in or intending to initiate livestock operations shall register such operation with the Water Pollution Control Commission. If the State Department of Health determines that an operation does not constitute a water pollution problem, provisions for control facilities will not be required. If an operation is polluting state waters, the operator shall obtain a permit for waste water disposal and shall provide necessary water pollution control facilities. Requirements for such facilities are specified. Such facilities shall be operated so as to prevent water pollution. (Shelnut-Florida)

1062 - E3

CONTINUED RECYCLING OF CATTLE MANURE,

University of California, Davis.
C. L. Ferrell and W. R. Garrett.

Proceedings, Western Section, American Society of Animal Science, Vol. 24, p. 415-419, 1973, 5 tab., 5 ref.

Descriptors: *Cattle, *Farm wastes, *Recycling, Nitrogen, Calcium, Nutrient Requirements:, *Waste disposal, California.
Identifiers: *Ration, Digestion stalls, Forced air ovens, Digestibility.

Four Hereford steers were confined in digestion stalls and fed the basal ration at a maintenance level. Their manure and urine were recycled in forced air ovens at 100°C. for 48 hours. The recycled wastes were mixed, digested, then recycled again. It was found that the less digestible components of the feces increased while digestible components decreased substantially during each recycling. Less energy was digested in subsequent refeeding. Mineral and nitrogen content increased with each recycling, resulting in the only significant nutritional value of manure after recycling. (Frantz - East Central),

1063 — A1

AGRICULTURE AND ENVIRONMENT,

W. H. Garman.
Crops & Soils, Vol. 25, No. 9, p. 14-19, Aug.-Sept., 1973.

Descriptors: *Photosynthesis, *Water pollution, *Nitrates, Phosphates, Soils, Eutrophication, *Livestock, Agriculture, *Farm wastes, Farm animals, *Fertilizers, Feed lots, Algae, Plankton, Nutrients, Carbon dioxide, Wells, Lakes, Balance of nature.

Questions regarding agriculture and the balance of nature are answered. The use of nitrogen fertilizers can under some circumstances be harmful to farm animals, but has never presented a human health problem. Farming and nitrate fertilizers seldom, except under extreme circumstances, contribute to nitrate levels in streams, lakes, and water wells. Fertilizers seldom cause excessive algae growth. Long term experiments show that fertilizer use has not damaged soils. (Frantz - East Central).

1064 — A7, A8, C5

TOXICITY TO HOUSE FLIES AND HORN FLIES OF MANURE FROM INSECTICIDE FED CATTLE,

Entomology Research Division, Agricultural Research Service, Kerrville, Texas, U. S. Department of Agriculture.
R. O. Drummond.
Journal of Economic Entomology, Vol. 56, No. 3, p. 344-347, June, 1963, 2 tab., 6 ref.

Descriptors: *Toxicity, *Farm wastes, Feed lots, Larvae', *Insecticides.
Identifiers: *House flies (Musca domestica), *Horn flies (Haematobia irritans) Bayer 22408, Butonate, Bayer 37342, Famophos, Bayer 37341, Thodia IP 9805, Dipterex, V-C 13, General Chemical 1072, Bayer 29493, Stauffer P-1504, Chlorinated hydrocarbons, U.S. Department of Agriculture Animal Disease and Parasite Research Division.

Insecticides were added to cattle rations on long and short term experiments. In a 91-day test Co-ral and Bayer 22408 proved 100% effective in preventing development of larvae of horn flies and partially effective against house flies in the manure tested. Ten insecticides were used in 10-day tests. Some insecticides were effective against both species, while others were at least partially effective with either or both. (Frantz - East Central)

1065 — E2

EFFECTS OF SWINE LAGOON EFFLUENT OF THE SOIL AND PLANT TISSUE,

Iowa State University, Ames. Department of Agricultural Engineering; Department of Agricultural Engineering; and Department of Agronomy, respectively.
C. V. Booram, T. E. Hazen, and L. R. Frederick.
Presented at 1973 Annual Meeting, American Society of Agricultural Engineers, University of Kentucky, Lexington, Kentucky, June 17-20, 1973, 19 p., 17 tab., 1 fig., 16 ref.

Descriptors: *Hogs, Cattle, Iowa, *Farm wastes, Confinement pens, *Lagoons, Anaerobic conditions, *Effluents, *Nutrients, Electrical conductance, Salts, *Waste disposal, *Irrigation, *Toxicity, *Water pollution, Corn (field), *Soil contamination, Water quality.
Identifiers: *Clarion-Webster Soil, Tile-drained grass plots, Plant tissues.

Twelve 40 x 60 feet tile drained plots of Clarion-Webster soil were given applications of anaerobic lagoon effluent. The soil received 0, 3.7, 11.3, and 22.6 inches of effluent per season. There were no significant plant population differences at the 0.10 level. Corn tissues were analyzed for 14 nutrients. (N,P,K,Mg,Ca, Na, Si, Mn, Fe, Cu, Zn, Al, Sr, and Mo). In the tissue analysis P, Na, Fe and Al increased while Mg content decreased with increasing applications of effluent. After 4 years of anaerobic lagoon effluent applications the electrical conductivity of the soil showed little change, (Frantz - East Central).

1066 — A3, C2, C3, C4, C5

WATER POLLUTION BY SWINE PRODUCTION OPERATIONS,

University of Missouri, Columbia, Department of Agricultural Engineering.
J. Robbins.
PH. D. Thesis, North Carolina State University, Department of Biological and Agricultural Engineering, 1970, 440 p., 48 tab., 51 fig., 57 ref.

Discriptors: *Effluent, *Waste disposal, Hydrographs, *Hogs, North Carolina, Nutrients, Lagoons, Soils, Runoff, Influent, Bacteria, Surface waters, *Water pollution, Drainage, Streams, *Farm wastes, Hydrologic systems, Sampling, Biochemical exygen demand, Nitrogen, Phosphates, Biodegradation.
Identifiers: *Organic carbon.

Seven swine production operations, three using lagoons, one direct discharge, two land disposal, and one control watershed were studied to determine the extent of effluent contribution to stream pollution. Data were collected to determine the effluent strength to be discharged into streams. An analysis was made for more than 1000 effluent and stream samples. An organic carbon analysis was successful in determining strengths of wastes and waste waters. The biochemical oxygen demand (BOD)/total organic carbon (TOC) ratio provided an indication of the ease of biodegradation and/or the degree of stabilization. It was found that anaerobic lagoons are not satisfactory as the sole means of treating hog wastes. Direct discharge of wastes into water creates gross pollution and should be prohibited. Land disposal was found to be the superior method for protecting water quality. Slope, degree of erosion, and drainage patterns are the important factors in determining the quality of streams draining agricultural basins. (Frantz-East Central).

1067 — A5, B1, E2

ANALYSIS OF ANIMAL WASTE STORAGE AND LAND DISPOSAL SYSTEMS,

R. Nordstedt.
PH. D. Dissertation, Ohio State University, Department of Agricultural Engineering, 1969, 101 p., 25 tab., 17 fig., 3 ref.

Descriptors: *Farm wastes, Odor, *Waste disposal, *Waste storage, Air pollution, Livestock, Feed lots, Fertilizers, Nutrients, Nitrates, Effluent, Diffusion.
Identifiers: *Scheduling model.

Systems which interact with storage and land disposal of farm wastes were analyzed and relevant interfaces and variables were identified. A mathematical model describing storage of wastes and their timely disposal on agriculture land was developed and tested. Odor nuisance potential of farm wastes spread on land was also deliniated. A scheduling model was developed. It could be an effective tool in the design and operation of waste storage and land disposal systems. The model takes into account all important system variables. The waste storage facility was the most significant investment, based on results of the scheduling study. Nutrient effectiveness as a function and land availability were significant. The pattern of the latter was a critical factor in determining minimum storage capacity. (Frantz - East Central).

1068 — B1, D2, D3, E3

NEW FEEDLOT CONCEPT USES CONVERTED MANURE AS FEED,

T. Zurowski.
Feedlot Management, Vol. 15, No. 8., p. 26. Aug., 1973, 1 fig.

Descriptors: *Recycling, *Farm wastes, *Cattle, *Feed lots, *Nutrients, *Feeds, Economics, Bacteria.
Identifiers: *Refeeding., Cowmel, Farm Ecology Company, Food and Drug Administration, *Cowdominium.

A Washington operation, Farm Ecology, has made plans for a cowdominium. This is a feed storage and a waste conversion plant. There the wastes are subjected to heat, pressure and either acidic or alkaline chemicals. The recycled product, Cowmel, is a highly nutritious and finely ground pellet. Economic feasibility and FDA approval is presently uncertain. (Frantz - East Central).

1069 — E2

MANURING OF POTATOES ON FEN SILT SOILS IN HOLLAND, LINCOLNSHIRE,

Agricultural Development an dAdvisory Ser'vice. Cambridge: Rothamsted Experimental Station.
C Berryman, T. Batey, T. H. Caldwell, and D. A. Boyd.
Journal of Agricultural Science, Vol. 80, p. 269-281, April, 1973, 12 tab., 1 fig., 17 ref.

Descriptors: *Silts, *Fertilizers, *Potatoes, Nitrogen, Phosphorus, Potassium, *England *Nutrients, Drainage, *Farm wastes, *Waste disposal, Soil profiles.
Identifiers: *Tuber blackening.

Eighteen potato manurial experiments were conducted on silt soils in England between 1953 and 1963. The mean response to nitrogen in these soils was much larger than in most English soils, but responses were varied from site to site. The nitrogen was effective in increasing tuber size and yield of ware; Phosphorus increased tuber numbers and decreased ware percentage, Because of the heavy potassium content of the soils tested, responses to the potassium were slight. Cooking tests showed little effect of manurial treatment on the amount or degree of tuber blackening. The recommended fertilizer nutrient requirements for light and medium silt soils are N—200 kg/ha, P_2O_5—130 ka/ha, and K_2O—190 kg-ha. The same nutrient recommendations for the heavy silt soils were 200 kg-ha, 310 kg-ha, and 100 kg-ha respectively. (Frantz - East Central).

1070 — D4, E3

PERIODICITY OF THE BLUE-GREEN ALGAE AND THEIR EFFECT ON THE EFFICIENCY OF MANURE-DISPOSAL LAGOONS,

Agricultural Engineering Research Division, Agricultural Research Service, U. S. Department of Agriculture; National Bontanic Gardens, Lucknow, India, respectively.
H. J. Eby, and V. P. Singh.
Government Printing Office No. 0100-1575, Washington, D. C., April, 1972, 8 p., 2 tab., 2 fig.

Descriptors: *Recycling, Nutrients, *Waste water, *Lagoons, *Algae, Bacteria, *Sewage, Oxidation, Climatic zones, Proteins, Farm wastes.

Identifiers: *India Waste disposal lagoons, Seasonal growth.

Research was done to provide a starting point for expanding feed production and aiding in the biological purification of waste water. Research in India reveals that blue-green algae has self-limiting tendencies and may be used advantageously. Since growth periods in the species vary, scientists might possibly anticipate each specie's population peaks thereby controlling algae growth. Harvesting of algae serves two purposes: (1) to remove organic matter from becoming a pollutant, and (2) to serve as potential livestock and poultry feed. (Frantz - East Central).

1071 — B2, C5, D4

A COMPARISON OF THREE SYSTEMS FOR TRANSPORT AND TREATMENT OF SWINE MANURE

Agricultural Engineering Department, Ames, Iowa; Agricultural Engineering Department, Corvallis, Oregon.
H. L. Person, J. R. Miner, T. E. Hazen, and A. R. Mann.
Presented at the 1972 Annual Meeting, American Society of Agricultural Engineers, Hot Springs, Arkansas, June 27-30, 1972, Paper No. 72-439, 30 p, 2 tab., 8 fig., 6 ref.

Descriptors: *Hogs, *Waste treatment, *Farm wastes, Feed lots, Iowa, *Aerated lagoons, *Oxidation lagoons, *Effluent, Nutrients, Bacteria, Fungi, Slime, Odor, Pumping, Maintenance, Water quality.
Identifiers: *Waste transport, *Waste management systems, Rotating biological contractor, Flushing gutter, Hydraulic cleaning.

Four engineers have demonstrated and evaluated three systems for hydraulic transportation and disposal of manure. The aeration basin, lagoon aeration basin, and rotating biological contractor systems all successfully used treated effluent as a cleaning medium in swine farrowing and finishing buildings. Aeration basins treated liquid manure. Pumping was done economically and excess water proved virtually odorless. The process didn't add significantly to either water pollution or animal health problems. Systems and equipment are described in detail. (Frantz - East Central).

1072 — C5, E2

HUMAN AND ANIMAL WASTES AS FERTILIZERS

The Metropolitan Sanitary District of Greater Chicago; University of Nebraska, Lincoln; University of Missouri Columbia, respectively.
J. R. Peterson, T. M. McCalla, and G. E. Smith.
Fertilizer Technology and Use, 2nd edition, Soil Science Society of America, p. 557-596, 1971, 37 tab., 8 fig., 42 ref.

Descriptors: *Farm wastes, *Sewage, *Waste disposal, Irrigation, Nitrates, Soil profiles, Lagoons, Pathogenic bacteria, *Fertilizers, *Water pollution, *Soil contamination, Odor, Leaching, Chemical properties, Physical properties, Microbial composition, Crops, Toxicity.
Identifiers: *Human wastes, Plant yields, Digested sludge.

Solid waste from municipal wastewater treatment plants in the United States is analyzed quantitatively and qualitatively. If properly digested, the sludge has little odor and is relatively free of pathogens. The use of digested sludge to ameliorate spoils has been proven. Three years' use of digested sludge on corn land has resulted in increased grain yields with no visual toxic symptoms to the plants. Qualitative and quantitative studies were also made on animal wastes. Although most pathogens are generally destroyed in the holding of wastes, weed infestations may be a problem with the application of animal waste to soil. Specific instances of waste utilization for soil improvement are cited for various states. (Wetherill - East Central).

1073 — C3, E2

NITRATE CONTENT OF PERCOLATES FROM MANURED LYSIMETERS

University of Guelph, Guelph, Ontario, Department of Land Resource Science.
D. G. Bielby, M. H. Miller, and L. R. Webber.
Journal of Soil and Water Conservation, Vol. 28, No. 3, p. 124-126, May-June, 1973, 4 tab., 3 ref.

Descriptors: *Nitrates, *Farm wastes, *Lysimeters, *Corn, Slurries, *Waste disposal, Groundwater, Soils, *Poultry, Irrigation, Denitrification, Ontario.
Identifiers: *Percolates, Guelph sandy loam.

The quantity and concentration of nitrates in percolates from lysimeters receiving liquid poultry manure applications were determined over a 3-year period. Nitrogen removed by corn, plus that in percolates, accounted for less than 25 percent of the amount applied to the soil. Most nitrates in the percolates were discharged from the lysimeters after corn harvest. The average concentration of nitrates in percolates from all treatments and for all years exceeded 10 parts per million. (Bielby, Miller, & Webber—University of Guelph).

1074 — B1, C5

SPRINKING CATTLE FOR RELIEF FROM HEAT STRESS

U.S. Department of Agriculture, Davis, California; Imperial Valley Field Station, El Centro, California, Department of Animal Science.
S. R. Morrison, R. L. Givens, and G. P. Lofgreen.
Presented at the 1972 Annual Meeting, American Society of Agricultural Engineers, Hot Springs, Arkansas, June 27-30, 1972, 12 p., 5 tab., 1 fig.

Descriptors: *Cattle, *Sprinkling, Feed lots, Air conditioning, Temperature, Performance, California.
Identifiers: *Heat stress, Respiratory rate.

Sprinkling cattle under shades during the summer in the Imperial Valley of California for one minute every 30 minutes when the temperature was above 80°F resulted in significantly higher feed consumption and rate of gain, compared with cattle under shades and not sprinkled. Efficiency of feed conversion, although favoring the sprinkling operation, was not significantly improved over that of uncooled cattle. Sprinkling was as effective as a refrigerated air conditioned barn at 75°F in one trial and more effective during a second trial. Sprinkling and refrigeration promoted greater comfort as indicated by the prevention of increases in respiratory rate and body temperature observed in the afternoon with control cattle. Both noncooled and cooled cattle consumed more feed and gained more weight with 40 feet per head of space than with 20 feet. (Morrison, Givens, & Lofgreen—U.S. Department of Agriculture & Imperial Valley Field Station).

1075 — B1, C5

THE EFFECT OF RATION ON ENGINEERING PROPERTIES OF BEEF CATTLE MANURE,

Agricultural Engineers, Chief Solid Waste Division, Lincoln, Nebraska Department of Environmental Control; Agricultural Research Service, University of Nebraska, Lincoln, U.S. Department of Agriculture.
G. A. Frecks, and C. B. Gilbertson.
Presented at the 66th Annual Meeting, American Society of Agricultural Engineers, University of Kentucky, Lexington, June 17-20, 1973, Paper No. 73-442, 24 p., 6 tab., 6 fig., 20 ref.

Descriptors: *Cattle, *Farm wastes, Kentucky, *Feeds, *Digestion, Volatility, Shrinkage, Porosity, Chemical properties, Physical properties, Volumetric analysis, Sieve analysis, Density, *Waste treatment, *Waste storage, Solids, Moisture content, Chemical oxygen demand, *Engineering.
Identifiers: *Ration, Drying rates.

Beef cattle were fed a high concentrate ration (HCR) and a high roughage ration (HRR) for five days. Samples of feces and urine were collected and analyzed to assist in the engineering design of materials handling and processing equipment and storage facilities. The total, volatile, and fixed solids content was not affected by the ration. Of the HCR wastes, 20% was retained on a 2mm. sieve as compared to 2% for the HRR wastes. Volume change from original moisture contents to dry solids was 55% for the HCR and 7.4% for the HRR feces. Due to its more porous structure the HRR feces dried at twice the rate of the HCR. (Frantz - East Central).

1076 — C4, D2, E3

HIGH-TEMPERATURE, HIGH PRESSURE EXTRUSION OF CHICKEN EXCRETA,

University of Kentucky, Lexington, Department of Agricultural Engineering; Department of Animal Sciences, respectively.
F. A. Payne, I. J, Ross, H. E. Hamilton, and, J. D. Fox.
Presented at the Annual Meeting, American Society of Agricultural Engineers, Hot Springs, Arkansas, June 27-30, 1972, Paper No. 72-450, 22 p., 1 tab., 6 fig., 17 ref.

Descriptors: *Farm wastes, *Poultry, *Waste treatment, *Recycling, *Temperature, *Pressure, Moisture content.
Identifiers: *Extrusion, Thermal destruction, Uric acid, Chemical changes, Physical changes, Sterilization, Flash volitalization, Microbial organisms.

Chicken excreta and an excreta-feed mixture were extruded at a temperature range of 250°-300°F. for periods of 8.6 to 31.4 seconds. Pressures of 300 to 600 psi were utilized with the high temperatures to aid in microbial destruction. An analysis includes chemical and physical changes in the extruded material, Also given is an equation which can be used to predict microbial destruction. When extruded, chicken manure (which normally contains disease organisms) may become a versatile, low-cost, and highly productive food material. (Frantz - East Central).

1077 — A2, A4, E2

SOIL CONDITIONS UNDER FEED LOTS AND ON LAND TREATED WITH LARGE AMOUNTS OF ANIMAL WASTES,

Southwestern Great Plains Research Center, Bushland, Texas, U. S. Department of Agriculture.
B. A. Stewart and, A. C. Mathers.
Contribution from Soil and Water Conservation Research Division, Agricultural Research Service, U.S. Department of Agriculture in cooperation with the Texas Agricultural Experiment Station, Texas A & M University, 3 p., 1 tab., 2 fig., 9 ref.

Descriptors: *Feed lots, *Farm wastes, *Water pollution, *Soil contamination, Cattle, *Nitrates, *Pollutants, Soil profiles, *Waste disposal, Water, Salt, Leaching.
Identifiers: *Soil conditions, Croplands,

Nitrate and other pollutants often accumulate in soil profiles under large feedlots. Water movement through these profiles, however, is usually very slow or does not occur, especially in the more arid areas. A greater pollution hazard results from spreading large amounts of animal wastes on cropland for the purpose of waste disposal rather than for improving soil conditions or crop growth and quality. A recent study showed that substantial quantities of nitrate accumulated when manure was applied to land at rates of 30 tons/acre or greater. Salt accumulation was also high enough to cause some injury to plant growth. Leaching can reduce the salt concentration, but may increase nitrate pollution of the drainage water. Indications are that pollution hazards are eliminated only when the growing crop utilizes most of the applied nitrogen. When the rate of manure application is too high, nitrate will accumulate in the soil and in some crops or will move through the soil with percolating water. (Stewart, Mathers--U. S. Department of Agriculture).

1078 — C3, C5

EXCRETION STUDIES IN SWINE FED ARSANILIC ACID,

Abbott Laboratories, North Chicago, Illinois, Nutrition Research Department.
L. R. Overby and, D. V. Frost.
Journal of Animal Science, Vol. 19, No. 1, p. 140-144, January, 1960, 2 tab., 9 ref.

Descriptors: *Arsenic, *Farm wastes, *Swine, *Diets, *Feeding, Poultry.
Identifiers: *Arsanilic acid.

The rates of arsenic excretion were determined in the feces and urine of swine receiving arsanilic acid at 30, 60 and 90 gm. per ton of feed. Much more arsenic was excreted in the feces than in the urine. After 10 days of arsanilic acid feeding, total excretion was in approximate balance with intake at the two lower levels of feeding. After the arsenical was withdrawn from the ration, the characteristic excretion level continued for two days, then decreased rapidly. This conforms with knowledge of the rate of disappearance of arsenic from tissues of animals fed arsanilic acid. The nature of the major part of the arsenical excreted was not determined. Unchanged arsanilic acid was not detected in the urine, but was present in the feces in an amount representing about 5% of the arsanilic acid consumed. (Overby & Frost—Abbott Laboratories).

1079 — C1, E3

UTILIZATION OF DIFFERENT LEVELS OF POULTRY LITTER NITROGEN BY SHEEP,

Virginia Polytechnic Institute, Blacksburg, Departments of Biochemistry and Nutrition and Animal Science.
A. N. Bhattacharya, and J. P. Fontenot.
Journal of Animal Science, Vol. 34, p. 1174-1178, 1965, 4 tab., 28 ref.

Descriptors: *Sheep, *Nitrogen, Fertilizers, *Protein, *Feeds, Farm wastes, Nutrition, *Chemical properties, Samples, *Metabolism, *Recycling.
Identifiers: *Digestibility, *Nitrogen retention, *Poultry litter, Peanut hulls, Crude protein, Soybean protein.

A series of three metabolism trials were conducted with eight yearling wethers to study the utilization of the nitrogen in auto-claved peanut-hull broiler litter, containing 22.0% crude protein (dry basis). Poultry litter nitrogen replaced approximately 25, 50 and 100% of the nitrogen of a purified ration containing isolated soybean protein as the nitrogen source. Apparent digestibility of crude protein in the rations decreased significantly with each increase in litter nitrogen level above 25%. However, the depression was small when litter supplied 50% of the nitrogen. When litter supplied 25 and 50% of the nitrogen, digestibility of litter crude protein calculated by difference was 67 and 69%, respectively, compared with 71% when only soybean protein was used. Nitrogen retention, expressed as grams per day, percent of nitrogen intake or percent of absorbed nitrogen, was significantly lower at the 100% litter nitrogen level than when no litter was used. There were no consistent differences in ammonia and non protein nitrogen content of rumen fluid and in concentration of various nitrogen fractions in the blood plasma of sheep fed the different rations. (Bhattacharya and Fontenot — Virginia Polytechnic Institute)

1080 — A3, F4

NITROGEN COMPOUNDS IN NATURAL WATER—A REVIEW,

U. S. Geological Survey, Menlo Park, California.
J. H. Feth.
Water Resources Research, Vol. 2, No. 1, p. 41-58, 1st Quarter, 1966, 9 tab., 1 fig., 87 ref.

Descriptors: *Nitrogen, Water, *Farm wastes, Groundwater, Public health, Fixation, *Nitrogen cycle, *Water pollution, Air pollution, Soil Contamination, Fertilizers, Proteins, Rocks, Leaching, Precipitation, Atmosphere, Ammonia, Aerosols, Water quality, Geochemistry.

Nitrogen compounds in natural water are significant in public health, agriculture, industry and geochemistry. The many sources of nitrogen compounds and the deep involvement of nitrogen in the life processes of organisms makes the study of such compounds difficult. The sources include natural aerosols, precipitation, fixation by micro-organisms in soil and water, decaying organic matter, and animal and industrial wastes, as well as probably undiscovered sources in consolidated and unconsolidated rocks. Nitrogen compounds are both oxidized and reduced by organisms. Some nitrogen compounds are absorbed on clay. The theoretical end product in water and the compound probably most often determined is NO_3-1. The concentration of nitrogen compounds ranges from 0.0 to > 100 ppm. (parts per million) in surface water and from 0.0 to > 1000 ppm. in groundwater. Seasonal fluctuations occur. Much further research is needed, including improvements in methods of analysis, further investigation of sources, and detailed study of the nitrogen cycle in small drainage basins. (Feth—U. S. Geological Survey).

1081 — D3, E3

CONVERTING ORGANIC WASTES TO OIL,

Pittsburgh Energy Research Center, Pittsburgh, Pennsylvania.
H. R. Appell, Y. C. Fu, S. Friedman, P. M. Yavorsky, and I. Wender.
Bureau of Mines Report of Investigation/1971, RI 7560, U. S. Department of Interior, 1971, 20 p., 10 tab., 3 fig.

Descriptors: *Recycling, *Sewage sludge, *Farm wastes, Agricultural wastes, Wood, Lignins, Water, Temperature, Catalysts, Solvents, *Conversion, *Oil, *Solid wastes.
Identifiers: *Low-sulfur oil, refuse, Carbon monoxide, *Liquid fuels, *Waste products, *Continuous reactor, Sucrose.

The Bureau of Mines is experimentally converting cellulose, the chief constituent of solid waste, to a low-sulfur oil. All types of cellulosic wastes, including urban refuse, agricultural wastes, sewage, sludge, wood, lignin, and bovine manure, have been converted to oil by reaction with carbon monoxide and water at temperatures of 350° to 400° C and pressures near 4,000 psig, and in the presence of various catalysts and solvents. Cellulose conversions of 90 percent and better (corresponding to oil yields of 40 to 50 percent) have been obtained. A continuous reactor for use at maximum conditions up to 500° C and 5,000 psig has been operated successfully. Using sucrose as a *feedstock*, operation in this system has permitted a simplified and preliminary chemical study of the conversion process. Oil yields of over 30 percent have been obtained with this unit. (Appell, Fu, Friedman, Yavorsky, & Wender - Pittsburgh Energy Research Center).

1082 — D2, E3

COSTS FOR LARGE SCALE CONTINUOUS PYROLYSIS OF SOLID WASTES,

Texas Tech University, Lubbock, Department of Chemical Engineering.
H. W. Parker, C. J. Albus, Jr., and G. L. Smith.
Presented at the 74th National Meeting, American Institute of Chemical Engineers, New Orleans, March 12, 1973, Paper 43 b-rv, 4 tab., 5 fig., 17 ref.

Descriptors: *Solid wastes, *Costs, Cattle, Feedlots, *Waste disposal, *Recycling, *Electricity, *Farm wastes, Gases, Fuels, Fertilizers, *By-products, *Sodium chloride.
Identifiers: *Pyrolysis, Municipal wastes, *Retort, Char, *Pollution abatement.

Conceptual process designs which utilize the recently developed TTU retort to pyrolyse 2,000 tons per day of either municipal solid waste or cattle feedlot waste are reported. The major product of these processes is the production of 30 megawatts of electricity. A governmental entity which could finance the required 15 million dollar investment with 6 per cent bonds over a 20 year period would have to charge users $1.70 per ton of municipal refuse processed or $0.70 per ton of feedlot waste pyrolysed. (Parker, Albus, Smith - Texas Tech University).

1083 — D2

CONTINUOUS SOLID WASTE—FEASIBILITY STUDY,

Dow Chemical Company, Freeport, Texas, Contract Research Department and Texas Tech University, Lubbock, Department of Chemical Engineering.
J. R. Massie, Jr., and H. W. Parker.
Paper presented to the 74th National Meeting of the American Institute of Chemical Engineers, New Orleans, March 12-15, 1973; Paper No. 43a, 31 p., 12 fig., 6 ref.

Descriptors: *Cattle, *Farm wastes, *Waste disposal, Recycling, *Solid wastes, Oxidation, Temperature, Energy, By-products, Economics, Texas, Air pollution, Water pollution, Drying.
Identifiers: Pyrolysis, *Continuous retort, Municipal refuse, Agricultural crop wastes, Char products, Fuel.

Continuous pyrolysis of a solid waste, cattle manure containing 30% moisture, was demonstrated in a six inch diameter retort at a mass flow rate of 136 lb/hr ft_2. The retort was an open cylinder with a grate at the bottom. Cyclic injection of oxygen containing and oxygen free gas served to limit the heated zone of the retort to its midsection, which contained no mechanical parts. Maximum temperatures in the hot zone were controlled by mixing oxygen free gas with the injected air. This retort may also be used for municipal refuse, agricultural crop waste, or natural resources such as oil shale and coal. When integrated into a process energy and by-products can be recovered from the retort as justified by economics, also air and water pollution problems can be easily controlled. (Massie, Parker - Dow Chemical Company).

1084 — D2, F5

CONVERSION OF URBAN REFUSE TO OIL,

Pittsburgh Energy Research Center, Bureau of Mines, Pittsburgh, Pennsylvania.
H. R. Appell, I. Wender, and R. D. Miller.
Conversion of Urban Refuse to Oil, Bureau of Mines Solid Waste Program, Technical Progress Report-25, U.S. Department of Interior, May, 1970, 5 p., 3 tab.

Descriptors: *Recycling, Temperature, *Sewage sludge, *Oil, Water, Gas, Steam, Sulfur, Organic matter.
Identifiers: *Processing, Furnaces, *Fuels, *Urban refuse, *Cellulosic wastes, Carbon Monoxide.

Urban refuse, cellulosic wastes, and sewage sludge have been converted to heavy oil by heating under pressure with carbon monoxide and steam. Conversion of the organic matter to oil, water, and gas have averaged near 90 percent at temperatures of 250° to 400° C and pressures of 1,500 to 5,000 psi. The yield of oil, based on the dry organic matter of the waste materials, is usually near 40 percent. This is the equivalent of more than 2 barrels of oil per ton of dry, ash-free waste material. The oil from urban refuse and cellulosic wastes has a sulfur content near 0.1 percent. This low sulfur content makes the oil from refuse a desirable source of fuel oil. (Appell, Wender, Miller - Pittsburgh Energy Research Center).

1085 — A2, B1, C1, D2

CHARACTERISTICS OF RAINFALL

RUNOFF FROM A BEEF CATTLE FEEDLOT,

Environmental Protection Agency
Robert S. Kerr Water Research Center,
Ada, Oklahoma.
R. D. Kreis, M. R. Scalf, and J. McNabb.
Environmental Protection Agency report number EPA-R2-72-061, September, 1972, 43 p., 10 tab., 2 fig., 26 ref.

Descriptors: *Cattle, *Confinement pens, *Rainfall-Runoff relationships, *Pollutants, Farm wastes, Nutrients, Bio-chemical oxygen demand, Chemical oxygen demand, Coliforms, Streptococcus.
Identifiers: *Feedlot, *Manure wastes, *Wastes characteristics, Solids, Total organic carbon.

Rainfall runoff from a 12,000-head capacity commercial beef cattle feedlot was characterized and a treatment-disposal system used by the feedlot was evaluated. Fifty percent of the rainfall events produced measurable runoff from the feedpens. A four-to ten-inch manure mantle of the feedpen surface was found to prevent runoff from 0.2— to 0.3-inch rainfalls depending on intensity and antecedent moisture conditions. The total runoff from the feedpens was equivalent to 30 percent of the total rainfall during the study period. Direct runoff from the feedpens contained pollutant concentrations in the form of oxygen demand, solids, and nutrients that were generally an order of magnitude greater than concentrations typical of untreated municipal sewage. Dilution from direct rainfall and a few days of sedimentation in the runoff collection ponds reduced the concentrations of the pollutants up to 90 percent. The total weight of solids and oxygen demanding materials was reduced by about one-half, but the total weight of nutrients was not significantly reduced. The remainder of the treatment disposal system produced no appreciable improvement in the quality of the waste water. Final discharges still contained pollutant concentrations two to three times those of untreated municipal sewage. (Kreis, Scalf, McNabb - Environmental Protection Agency).

1086 — E3

THE EFFECT OF FEEDING LAYING HENS VARIOUS LEVELS OF COW MANURE ON THE PIGMENTATION OF EGG YOLKS,

A.R.S. Animal Science Research Division, Poultry Research Laboratory, Georgetown, Delaware, U. S. Department of Agriculture.
L. H. Littlefield, J. K. Bletner, and O. E. Goff.
Poultry Science, Vol. 52, No. 1, p. 179-181, January, 1973, 3 tab., 10 ref.

Descriptors: *Recycling, Cattle, *Farm wastes, Poultry, *Diets.
Identifiers: *Blood xanthophyll levels, *Yolk pigmentations, Blood.

Dried cow manure was added at the rate of 0, 2.5, 5, or 10 kilograms per 100 kilograms of diets containing 0 and 23 milligrams of xanthophylls per kilogram of diet to determine the effect on blood xanthophyll levels and the pigmentation of yolks produced by hens on these diets. There was a high positive linear correlation between the amount of cow manure added and the amount of xanthophyll in the blood, the amount of xanthopyhll in the egg yolk and the yolk visual score. There was a high negative linear correlation between pigmenting efficiency and the amount of cow manure added to the diet. Although cow manure was a good source of xanthophylls, it was not efficiently utilized by the hen as a source of xanthophylls. (Littlefield, Bletner, Goff - U.S. Department of Agriculture).

1087 — A6, C3

ENRICHMENT OF THE ATMOSPHERE WITH NITROGEN COMPOUND VOLATILIZED FROM A LARGE DAIRY AREA,

Soil scientists, U. S. Department of Agriculture, and Staff Research Associate, University of California, Riverside.
R. E. Leubs, K. R. Davis, and A. E. Laag.
Journal of Environmental Quality, Vol. 2, No. 1, p. 137-141, January-March, 1973, 3 tab., 3 fig., 18 ref.

Descriptors: *Dairy industry, *Cattle, *Nitrogen, Ammonia, *Air pollution, Feed lots, *Water pollution, Toxicity, *Farm wastes, Sampling, Temperature, Humidity, Winds, Rainfall.
Identifiers: *Distilled nitrogen, Nondistillable nitrogen, Atmospheric NH_3, Enrichment.

A dairy cow population of 143,000 in an area of 150 KM_2 enriched the atmosphere with distillable N (mostly NH_3) over an area in excess of 360 KM_2, over an area of 35 KM_2, where cow population density was approximately 1,600 cows KM_2, the concentration of distillable N in the atmosphere was between 20 and 30 times greater than at a control site outside the dairy area. Highest concentrations of N were associated with wet corral surfaces and favorable evaporative conditions. Approximately 20% of the total N absorbed by acid-surface traps in the dairy area was nondistillable N while filtered air samples contained 5% or less. Rainfall delivered three times as much N to the land surface inside than outside the dairy area.. (Luebs, Davis, Laag-U.S. Department of Agriculture and University of California).

1088 — C5

OBSERVATIONS ON THE EFFECT OF PROTEIN INTAKE AND STAGE OF GESTATION ON THE PROPORTION OF URINARY NITROGEN EXCRETED AS UREA IN SHEEP,

Rowett Research Institute, Bucksburn, Aberdeen, AB2 9SB.
J. J. Robinson, D. Scott, and C. Fraser.
The Journal of Agricultural Science, Vol. 80, No. 3, p. 363-368, June, 1973, 3 tab., 4 fig., 14 ref.

Descriptors: *Sheep, Diets, Energy.
Identifiers: *Protein intake, *Gestation, *Urinary nitrogen, Nitrogen retention.

The effect of altering the level of protein intake on urea excretion in ewes was assessed in two separate experiments. In Experiment 1, 14 pregnant (during the last 20 days of gestation) and 10 non-pregnant ewes were each offered a different level of digested N intake in the range 5-25 g/day. At all levels of protein intake urea N excretion was lower in pregnant than in non-pregnant ewes. In Experiment 2, 21 pregnant ewe lambs were each offered one of three diets supplying mean intakes of 83 (T. 1), 113 (T 2) or 147 (T 3) g crude protein/day. During the last 100 days of gestation the mean levels of urea N excretion were 6.9, 11.0 and 15.2 g/:day for T 1, T 2 and T 3, respectively. The corresponding values for urinary N excretion were 9.3, 13.8 and 18.2 g/day. At all levels of protein intake urea N excretion was lower just prior to parturition than 95 days prepartum; the difference was correlated with lamb birth weight and maternal body-weight change. A notable feature of both experiments was the low level of urea N excretion by the pregnant ewes in late gestation, at low protein intakes. It would appear that when energy intake is adequate the decrease in urea N excretion associated with pregnancy is a direct result of an increased N requirement for maternal and/or foetal growth. (Robinson, Scott, and Fraser - Rowett Research Institute).

1089 — D4, E3

A RECYCLED FEED SOURCE FROM AEROBICALLY PROCESSED SWINE WASTES,

University of Illinois, Urbana, Agricultural Engineering Department and Animal Science Department, respectively.
D. L. Day, B. G. Harmon.
Presented at 1972 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 11-15, 1972, Paper No. 72-954, 10 p., 7 tab., 5 fig., 21 ref.

Descriptors: *Recycling, *Feeds, *Swine, *Farm wastes, Aerobic conditions, Water, Nutrients, *Oxidation lagoons, Proteins.
Identifiers: Odor control, Rats, *Waste management.

An intriguing amount of protein was noticed in swine oxidation ditch mixed liquor at the University of Illinois in 1967. Studies have been in progress since then to measure the nutritive value of the aerobically processed product and use it as a feed supplement in feeding trials to rats and hogs. Several methods of concentrating and feeding the product have been tried. Utilizing this product provides a source of water and nutrients for swine while minimizing environmental pollutants (air, water, soil). There is odor control and little if any effluent from the building. The results have been very favorable and economics appear competitive with other methods of waste management with a high degree of pollution control. (Day, Harmon - University of Illinois).

1090 — A7, A8, C5

COUMAPHOS AS A FEED ADDITIVE FOR THE CONTROL OF HOUSE FLY LARVAE IN COW MANURE,

Agricultural Research Service, Beltsville, Maryland and Tifton, Georgia, U. S. Department of Agriculture.
R. W. Miller, C. H. Gordon, N. O. Morgan, M. C. Bowman, and M. Beroza.
Journal of Economic Entomology, Vol. 63, No. 3, p. 853-856, June, 1970, 3 tab., 14 ref.

Descriptors: *Feeds, *Additives, *Cattle, *Farm wastes, Dairy industry, *Mortality, Milk, *Insecticides, Larvae.
Identifiers: *Coumaphos, *House flies, Musca domestic L.

The mortality of first-stage larvae of the house fly, **Musca domestica** L., seeded into the manure of dairy cows consuming 0-144 ppm coumaphos in their ration increased as the concentration of coumaphos in the ration was increased. At the 144 ppm level, larval mortality approached 100%. Although coumaphos residues were found in the feces no residues L 0.002 ppm) appeared in the milk of cows at any level of coumaphos fed. Neither feed intake nor milk production was affected by the feeding of coumaphos. The blood cholinesterase of 1 cow fed 150 ppm coumaphos over a 6-week period dropped to 20% of pre-experimental levels. (Miller, Gordon, Morgan, Bowman, Beroza - U. S. Department of Agriculture).

1091 — A7, A8, B3, C5

TOXICITY OF DROPPINGS FROM COUMAPHOS-FED HENS TO LITTLE HOUSE FLY LARVAE.

University of Massachusetts, Amherst, College of Agriculture, Department of Entomology and Plant Pathology.
J. S. Eversole, J. H. Lilly, and F. R. Shaw.
Journal of Economic Entomology, Vol. 58, No. 4, p. 709-710, August, 1965, 1 tab., 4 ref.

Descriptors: *Poultry, *Farm wastes, *Toxicity, *Insecticides, Massachusetts.
Identifiers: Flies, Larval: mortality, Coumaphos oral drench powder, Fannia canicularis, white leghorn hens.

White leghorn hens were fed mixtures of 50% coumaphos oral drench powder, and pelleted poultry feed. The insecticide levels were 0, 25, 75, and 125 mg of active ingredient per kg of feed. The mean mortalities of larvae of Fannia canicularis (L.) exposed to the droppings from these birds were 7.3, 18.O, 42.5, and 91.0%, respectively. Therefore coumaphos provided an effective degree of control when fed at the 125 mg/kg level. By a comparison of the concentrations of coumaphos required to produce approximately 90% mortality of the fly larvae in this field test with the results of our laboratory tests, it was estimated that approximately a 70-fold decrease in effectiveness occurred during passage of the insecticide through the birds. (Eversole, Lilly, & Shaw - University of Massachusetts).

1092 — A8, C5

EFFECT OF BACILLUS THURIENGSIS IN CATTLE MANURE ON HOUSE FLY LARVAE,

Animal Science Research Division, Agricultural Research Service, Beltsville, Maryland; Entomology Research Division, Agricultural Research Service, Beltsville, Maryland.
R. W. Miller, L. G. Pickens, and C. H. Gordon.
Journal of Economic Entomology, Vol. 24, No. 4, p. 902-903, August, 1971, 2 tab., 11 ref.

Descriptors: *Cattle, *Farm wastes, Larvae, *Mortality, Additives, Feeds, Poultry.
Identifiers: *Fly control, Bacillus thuringiensis Berliner, *Musca domestica L., Biotrol BTB-183.

A commercial formulation of Bacillus thuringiensis Berliner, 'Biotrol' BTB 183-25 W, was fed to dairy cattle in an attempt to control house fly, Musca domestica L., larvae in the feces. A maximum larval mortality of 33% was obtained when cows were fed 3200 ppm of this formulation. In an in vitro experiment, complete control of house fly larvae was obtained to a level of 12,800 ppm of feces. (Miller, Pickens, Gordon - Agricultural Research Service).

1093 — C3, E3

DEHYDRATED POULTRY MANURE AS A CRUDE PROTEIN SUPPLEMENT FOR SHEEP

Biological Waste Management Laboratory, Beltsville, Maryland, U. S. Department of Agriculture.
L. W. Smith, C. C. Calvert, and J. R. Menear.
Proceedings 1973 Maryland Nutrition Conference for Feed Manufacturers, The University of Maryland. The American Feed Manufacturers Association cooperating, March 15-16, 1973, p. 35-44, 15 tab., 1 fig., 14 ref.

Descriptors: *Farm wastes, *Arsenic, *Sheep, *Nitrogen, *Feeds, Growth, Nutrition, Chemical properties, *Recycling.
Identifiers: *Poultry manure supplemented diets, Feed additives, Digestibility, Soybean oil meal.

Despite possible arsenical residues, dehydrated poultry-manure supplemented diets were consumed by sheep as readily as diets supplemented with soybean oil meal. Nitrogen from broiler manure supplemented diets was not significantly less digestible than SBOM nitrogen and was retained in the sheep equally well. The true digestibility of DPM-N was determined to be 81%, a value of similar magnitude determined by others for dry-mixed conventional feeds. Arsenic from different sources ingested by sheep was detected in all tissues assayed. Withdrawal of arsenic from feed results in a rapid decrease in tissue arsenic concentration. Significance of arsenic in poultry manure processed for ruminant CP supplements will depend on individual feeding regimes, arsenic concentration in manure and permissible levels established for lamb and mutton. (Smith, Calvert, and Menear - U.S. Department of Agriculture).

1094 — F1, F3

AGRICULTURE AND POLLUTION SOCIO - ECONOMIC ASPECTS,

University of Kentucky, Lexington, College of Agriculture.
A. F. Bordeaux, Jr.
Presented at the College of Agriculture Annual Conference, University of Kentucky, January 5-7, 1971, p. 1-7, 6 ref.

Descriptors: *Water pollution, *Economics, Surface waters, Technology, *Fertilizers, Conservation, Insecticides, *Farm wastes, Nitrates, Farm prices, Costs, *Waste disposal, Water treatment, DDT, Regulation, Kentucky, Agriculture.

As the interest in environmental protection heightens in the United States, farmers are increasingly criticized as pollutors of air and water. Costs of pollution must be met and farmers, declining in political power, feel the most pressure. Alternative chemicals are available to replace the DDT family, but they are less effective and more expensive, Providing for economical environment protection requires the cooperative efforts of economists, engineers and scientists. (Frantz - East Central).

1095 — A1, F4

BIOLOGICAL ASPECTS OF AGRICULTURE'S EFFECTS ON ENVIRONMENTAL QUALITY,

University of Kentucky, Department of Entomology.
H. W. Dorough.
Presented at the College of Agriculture Annual Conference, University of Kentucky, January 5-7, 1971, p. 8-13.

Descriptors: *Agriculture, Kentucky, Runoff, Farm wastes, Surface waters, *Insecticides, Toxicity, Soils, Dairy industry, Erosion, Fertilizers, Livestock, *Air pollution, *Water pollution, *Soil contamination, Sedimentation.
Identifiers: *Tobacco Industry, *Environmental quality.

Agriculture depends upon maintaining a quality environment. But, it may have various detrimental effects on that environment. The Environmental Quality Task Force in the University of Kentucky College of Agriculture was established to evaluate the following problems: pesticides, sediment, farm wastes and fertilizers. Concentrated pesticide use contaminates surface water, air and especially soil, Erosion and sedimentation aid in the transportation of pollution in streams. The phosphorus and nitrogen from farm wastes and certain nutrients from fertilizers are major sources of water pollution. Evaluation of the general use of pesticide contamination problem in Kentucky indicates cause for concern, but the situation is not yet critical. (Frantz - East Central).

1096 — D1, E1, F4

ENGINEERING AGRICULTURAL WASTES,

University of Kentucky, Lexington, Agricultural Engineering Department.
B. J. Barfield, H. E. Hamilton, and I. J. Ross.
Presented at the College of Agriculture Annual Conference, University of Kentucky, January 5-7, 1971, p. 8-13.

Descriptors: *Dehydration, Land use, Proteins, Erosion, Technology, *Waste disposal, Lagoons, Kentucky, Insecticides, Odor, Livestock, Oxidation lagoons, *Farm wastes, *Air pollution, *Water pollution, *Soil contamination.
Identifiers: Composting, Microbial disposal.

The extension of cities into farming areas, demands for more uniform quality products, increased farm production and increasing demands for processed foods are among recent trends causing problems for agricultural waste management. Soil erosion accounts for approximately 88% and livestock wastes for 11% of all agricultural pollution. But the amount of livestock waste that must be handled by mass management methods is expected to double by 1980. Soil disposal and microbial disposal media are the most common while composting and dehydration are also used, All agriculture waste problems must be met with technological, social economical acceptability. (Frantz - East Central).

1097 — A4, C3

NITRATE CONCENTRATIONS IN GROUNDWATER BENEATH A BEEF CATTLE FEEDLOT,

U. S. Department of Agriculture, Gunnison, Colorado and U. S. Department of Agriculture, Lincoln, Nebraska.
J. C. Lorimor, L. N. Mielke, L. F. Elliott, and J. R. Ellis.
Water Resources Bulletin, Vol. 8, No. 5, p. 999-1005, October, 1972, 3 tab., 4 fig., 6 ref.

Descriptors: *Nitrates, *Cattle, *Feed lots, *Water pollution, Irrigation, *Farm wastes, *Groundwater, *Water quality, Aquifer, *Samples, Nebraska, Wells.
Identifiers: 3-day study, transmissvity.

A study of nitrate concentration in the groundwater beneath a beef cattle feedlot near Central City, Nebraska was started in 1968. An intensive 3-day pumping study was conducted at the feedlot at the start of 1970 irrigation system. Little nitrate concentration was found in the groundwater coming from beneath the feedlot. Pumping caused a slight increase in nitrate concentration over the average concentration for the previous 2 years. (Lorimor, Mielke, Elliott, Ellis - U. S. Department of Agriculture).

1098 - E4, F5

BIBLIOGRAPHY OF PRODUCTS DERIVED FROM AQUATIC ORGANISMS.

Coastal Plains Center for Marine Development Services, Wilmington, N.C.

Center Publication No 71-3, August 1971. 113 p.

Descriptors: *Aquatic plants, *Fish, Poultry, Mink, Swine, Ruminants, Feeds, *Water pollution control, Sewage treatment.
Identifiers: *Animal husbandry, *Fish protein.

367 REFERENCES INCLUDE INFORMATION ABOUT BOTH FOOD AND MEDICAL PRODUCTS WHICH CAN BE OBTAINED FROM AQUATIC ORGANISMS. References on direct consumption of sea products, such as fishing methods and the use of fresh fish or shellfish, are excluded. Main emphasis is on conversion of aquatic plants and animals to products such as fertilizers, food supplements for domestic animals and man, drugs, other pharmaceuticals, and aquatic organisms for water pollution control. There is a permuted title index and an author index.

1099 - C4

SUMMER CONFERENCE OF SOCIETY FOR APPLIED BACTERIOLOGY, LIVERPOOL, 13--15 JULY 1971,

Office of Naval Research, London (England).
G. A. Hottle. Report No. ONRL-C-19-71,
31 August 1971. 12 p, 11 ref.

Descriptors: *Microorganisms, *Water pollution control, *Wastes, *Pathogenic bacteria, Conferences, *Public health, Rivers, *Sewage, Biochemical oxygen demand, Solid wastes, Ammonia, Nitrogen compounds, Nitrates, Phosphates, Sludge treatment, Dissolved oxygen, Bacteria, Fungi, Protozoa, Fermentation, Bacteriophage, Nutrients, Filters Equipment, Oxidation, Lakes, Wisconsin, Anaerobic digestiion, Algae, Eutrophication, Biodegradation, Plastics, Phosphorus compounds, Soil fungi, Pseudomonas, Dairy industry, Municipal wastes, Herbicides, Soil bacteria, Pesticides, Industrial wastes, DDT, Trace elements, Water quality, Detergents, Farm wastes, Urine, Aerobic bacteria, Carbohydrates, Bactericides, Clostridium, Streptococcus, Salmonella, Water purification, Sheep, Yeasts, Foods, Anaerobic bacteria, Soil contamination, Waste treatment, Organic matter, Digestion, Activated sludge, Actinonycetes, Hydrocarbon pesticides, Viruses, Water pollution sources, Water pollution effects, Path of pollutants.
Identifiers: Bdellovibrid, Pelodictyon, Polioviruses, Plasticizers, Phthalate, Thermophilic fungi, Polyethylene, Polypropylene, Bacillus, Corynebacteria, Streptothrix hyorhina, Cadmium, Dimethylnitrosamine, Amines, Carcinogens, Torulopsis spp., Aspergillus, Penicillium, Fusaria, Vibris.

The annual conference of the Society for Applied Bacteriology, held at the University of Liverpool, 13-15 July 1971, included a two-day symposium on 'Microbiol Aspects of Pollution' and a one-day session devoted to papers on individual research.

The following topics were discussed: (1) water pollution by domestic, agricultural and industrial wastes, (2) sewage treatment using combined aerobic-anaerobic systems, (3) microbial ecology of the activated sludge process, (4) microbial aspects of pollution in the food and dairy industry, (5) pollution of freshwaters with inorganic nutrients, (6) microbial degradation of plastics, herbicides, and pesticides, (7) aerobic methods for the treatment of farm wastes, (8) factors affecting algal blooms, (9) the role of obligate anaerols in the digestion of organic material, (10) health hazard of pollution, and (11) sewage pollution of natural waters. Individual research topics included (1) 'An Evaluation of Procedures for Enumerating Bacteria in Activated Sludge', (2) 'The Microbial Pollution of Water Courses as a result of the Sewage and Animal Wastes and the Application of Animal Slurry to Land', and (3) 'Methods for Analyzing the Microbial Decay of Solid Wastes'. (Jefferis-Battelle)

1100 - C3

DETERMINATION ON MERCURY IN SAMPLES FROM THE DUTCH ENVIRONMENT,

Interuniversitair Reactor Instituut, Delft (Netherlands).
J. J. M. De Goeij. Report No IRI-133-71-17, 1971. 21 p, 12 fig, 1 tab, 10 ref.

Descriptors: *Mercury, *Neutron activation analysis, Chemical analysis, *Industrial wastes, *Pollutant identification, Water pollution sources, Heavy metals, Separation techniques, Irradiation, Sediments, Cattle, Birds, Foods, Plants, Marine fish, Toxicity, Milk, Water analysis, Marine animals, Salmon, Herrings, Commercial fish, Automation.
Identifiers: *Biological samples, *Methyl mercury, *Rhine River, Seals (Animals), Tuna, Mackerel, Pilchard, Cod, Haddock, Liver, Brain, *Netherlands, Body fluids, Environmental samples.

Samples of sediments; biological tissues and fluids (birds, fishes, and man); human hair; foodstuffs; industrial products and pharmaceuticals; and plants and water were analyzed for mercury by neutron activation analysis. These samples, ranging from 100 mg-1/g, were irradiated in quartz vials, automatically decomposed and oxidized by sulfuric acid and hydrogen peroxide, and volatilized at 200C with HBr into a sodium acetate solution. Inactive mercury was added to the solution and stirred for 1 hr to break the mercury into small droplets to ensure isotopic exchange. The Hg was then collected on a sintered glass filter, washed with water then acetone, and finally dissolved in nitric acid and counted in a well type sodium iodide crystal. A sensitivity and an accuracy of 1.0-0.1 ppb/gram sample and 97-98 percent yield were achieved, respectively. Results showed that (1) one quarter of the birds tested had been killed by methylmercury; (2) in the food chain: sediments - grass - cow - milk, cumulative effects were absent; (3) Rhine River sediments showed increases of 18-23 ppm compared to previous tests; and (4) while Dutch fish, seals and coastal marine organisms were generally contaminated, imported canned fish and cod liver oil were in low ranges. Separate measurements showed not only that tuna had higher concentrations but that about 80 percent of the mercury in all fish was present as lipophilic methylmercury. (Mackan-Battelle)

1101 — C4, D4

BACTERICIDAL EFFECTS OF ALGAE ON ENTERIC ORGANISMS,

Texas University, Austin, Center for Research in water resources.
Ernest Davis, and Earnest Gleyna.
FWPCA grant 18050 DCL, Technical Report EHE-70-06, CRWR-55, 132 p. March 1970, 9 fig., 144 tab., 60 ref.

Descriptors: *Algae, *Cultures, *Enteric Bacteria, *Oxidation lagoons, *Pathogenic bacteria.
Identifiers: Autogomistic effects, *Axenic cultures, *Dieoff fates, Aftergrowth, Blue-green algae, Field studies, Green algae, Laboratory studies.

A series of experiments involving the effects of blue-green and green algae on the dieoff rates of selected bacteria were conducted. Aexmic cultures of anabaena cyclindrica, A. niculans, oscillatoria chalybia, chlorella pyrenoidoso and scendedesm obluguus among others. Cultures of enteric bacteria species (adcaligeues, faecalis, enterobactec aerogenes, E. coli proteus vulgaris, psudomonas aerorginosa, and serratio marcercens) were added to the oxenic algal cultures during different periods of the algal life cycles. Filtrate from actively growing algae was exposed to cultures of enterics to determine whether any antibiotic compounds were imparted to the medium during lag phase growth of algae. To determine aftergrowth of the enteric species, the duration of the tests was extended to about 90 days. Mixed cultures of green and blue-green algae were exposed to both single species of enteric bacteria and mixed cultures. Mixed algal cultures cause a greater dieoff among the enteric bacteria than do individual species of algae. The dieoff characteristics of pathogenic species, namely Salmonella Typhosa, S. Paratyplin, Shigella Cysentiriae, S. Paracysentesiae, and Vibrac Comma were also determined. The pathogenic species did not survive as long as the enteric test species under similar test conditions. Virtually no aftergrowth was detected on the part of Pathogenes. (Aguirre - Texas).

1102 - C4, D4

MICROBIOLOGY OF A WASTE STABILIZATION POND,

Central Public Health Engineering Research Inst., Nagpur (India).
M. V. Bopandikar.
In: Advances in Water Pollution Research, Proceedings Fourth International Conference on Water Pollution Research, held in Czechoslovakia, April 21-25, 1969: London, Pergamon Press, Ltd, Sec II, Paper 16, September 1968. 7 p, 32 ref.

Descriptors: *Biological treatment, *Microbiology, *Oxidation lagoons, Bacteria, Efficiencies, Lagoons, Microorganisms, Organic Loading, Pathogenic bacteria, Ponds, Viruses.
Identifiers: *Bacterial removal, Viral removal.

Stabilization ponds developed by the author in India successfully treat sewage with an average BOD of 300 mg/l to 10 mg/l at a cost of only Rs. 40,000/MGD as against Rs. 1,000,000/MGD with conventional treatment. No work, however, has been done in India on the reduction of pathogens by pond stabilization treatment. Many variables affect the types and quantities of enteric viruses that occur in sewage and the limitations of available techniques for their detection further complicate attempts to judge their significance. A review of the techniques developed for sampling and concentration of viruses from large volumes of water is presented. Methods employed for collecting sewage samples for quantitative determination of viruses include: (1) the gauge pad or swab method, (2) resin adsorption method, and (3) ultra-centrifugation. It is shown that conventional secondary treatment (including chlorination) is not effective in removing virus contamination. However, marked reduction in the yield of viruses occurred during passages through oxidation ponds. Reduction in coliforms of fecal E. coli and fecal streptococci during 30 days passage through oxidation ponds ranged between 96.0 and 99.9%.

(Aguirre-Texas)

1103 - A3, A4, F3

ENFORCEMENT OF WATER POLLUTION LAWS IN OKLAHOMA.

Oklahoma Law Review, Vol 22, No 3, p 317-345 (1969). 29 p, 180 ref.

Descriptors: *Oklahoma, *Water pollution sources, *Administrative agencies, *Pollution abatement, Watercourses (Legal), Surface waters, Groundwater, Water supply, Water reuse, Water sources, Industrial wastes, Farm wastes, Sewage, Waste disposal, Waste treatment, Water users, Water quality, Standards, Wildlife conservation, Oil industry, Saline water intrusion, Toxins, Sediments, On-site investigations, Hydrologic cycle.

The article examines first the factors determining the nature and extent of water pollution: (1) the character of the state's water resources, their quality, quantity, and availability, and (2) the causes of water pollution categorized into the petroleum and other industries, agriculture, and municipal wastes. The second section of the article examines water pollution law as implemented by case law, legislation, or regulatory agencies' rules. Private remedies are discussed in regard to: (1) injuries to land and chattels; (2) nature of defendant's act; (3) nature of recovery; (4) plaintiff's standing; (5) defenses; (6) injury to water use rights; and (7) statute of limitations. The growth of a comprehensive state administrative program is explained. There are six agencies which administer this program: (1) the Pollution Control Coordinating Board has various coordinating functions; (2) the Water Resources Board performs industry plant inspections; (3) the Corporation Commission regulates the petroleum industry's activities; (4) the Health Department regulates the water supply and sewage disposal; (5) the Department of Agriculture regulates pesticides, and (6) the Department of Wildlife Conservation. (Rees-Florida)

1104 - A9, C4

FISH AS POTENTIAL VECTORS OF HUMAN BACTERIAL DISEASES,

Fort Detrick, Frederick, Md. Medical Sciences Labs.
Werner A. Janssen.
1970. 7 p, 40 ref.

Descriptors: Diseases, Vectors (Biology), Pathogenic bacteria, Pseudomonas, Fish, Oysters, Crabs, Clostridium, Salmonella, Shigella, E. coli, Bioindicators, Bullheads, White perch. Mycobacterium.
Identifiers: Aeromonas, Staphylococcus, Pasteurella, Leptospira.

The similarities between pathogens which infect humans and those found in fish suggests that fish may act as passive or active hosts for pathogens which infect man. Review of the relatively few studies conducted in the past and the author's own experience demonstrate the feasibility of this thesis. Because of the increased use of fish for food, the contamination of water, especially with human wastes, and the contact between man and the aquatic environment, research on this subject should be expanded. (Little-Battelle)

1105 - A2, F2

RULE AND REGULATION FOR THE REGISTRATION OF FEEDLOTS.

Nebraska Water Pollytion Control Council, Lincoln.

Nebraska Water Pollution Control Council, Lincoln, Neb, nd, 2 p.

Descriptors: *Nebraska, *Water pollution control, *Waste disposal, *Domestic animals, Legislation, Feeds, Water pollution sources, Water policy, Administrative agencies, Regulation, Programs, Standards, Streams, Rivers, Pollution abatement, Administration, Cattle, Poultry, Water fowl, Animals, Legal aspects, Waste disposal, Farm wastes.

The Nebraska Water Pollution Control Council is empowered to effectuate a comprehensive program of water pollution control. Feedlot registration is a necessary portion of an overall waste disposal inventory. For clarity in implementing this Regulation, the word 'feedlot' is defined as the confined feeding of food, fur, or pleasure animals in buildings, lots, or ponds not normally used for raising crops or grazing animals. The confined feeding of enumerated animals, when grouped in numbers herein specified, shall come under this regulation. Any confined feeding within 500 feet of any watercourse also comes within the provisions of the Regulation. Registration of existing feedlots, prior to July 1, 1968, and proposed feedlots, at least sixty days prior to construction, is mandatory. Such registration must be accomplished on forms supplied by the Council. Detailed information must be provided on each feedlot. A failure to register is made punishable by statutory penalties. (Rees-Florida)

1106 - A1, B1, F3

MANAGING OUR ENVIRONMENT.
Agricultural Research Service, Washington, D. C.

Dept of Agriculture, Washington D C, Agriculture Information Bulletin No 351, April 1971. 48 p.

Descriptors: *Management, *Environment, *Agriculture, *Water pollution control, Sediments, Farm wastes, Nutrients, Phosphorus, Algae, Nitrates, Water reuse, Salinity, Pesticides, Livestock, Waste disposal, Oxidation lagoons, Dehydration, Runoff, Radioactivity, Fallout, Biocontrol, Insect control, Irrigation, Predation, Parasitism, Insect resistance, Insect attractants, Precipitation (Atmospheric), Genetics, Erosion control, Air pollution, Trees.
Identifiers: Feedlots, Composting, Plant residues, Recycling food, Processing wastes, Pathogens, Bioenvironmental controls.

Some of the major problems in agricultural research dealing with new and older methods of environmental management are described in an effort toward interesting the public in preservation of the quality of our environment. General material is presented under the subjects 'Protecting land, water and waterways,' 'Management of farm wastes,' 'Recycling food processing wastes,' 'New ways to fight pests--alternatives to pesticides,' and 'A green world--a clean world.' Among the problems discussed are prevention of animal wastes reaching waters, phosphorus from human wastes and detergents, multiple water reuse, and salinity in irrigated lands of the Southwest. Scientists are trying to prevent pesticide residues in soil and water and avoid pesticide overuse. Fallout from nuclear weapon testing calls for various decontamination treatments; food processing waste disposal and recycling is described, and recovery of potable water from seawater by reverse osmosis. Alternatives to pesticides are destruction of insects and weeds by introduction of predators, parasites, and pathogens which feed on or infect pests; resistant varieties, attractants, genetic control, bioenvironmental controls, and hormone and daylight manipulation. (Jones-Wisconsin)

1107 - A2, A3, A4, F3, F4

WATER POLLUTION CONTROL LEGISLATION, AGRICULTURAL RUNOFF, PART 6.
Congress, Washington, D.C.

Hearings before the Committee on Public Works, Subcommittee on Air and Water Pollution, 92d Cong, 1st Sess. April 2, 1971. p 2515-3188, 64 fig, 208 tab, 9 chart, 420 ref.

Descriptors: *Agricultural chemicals, *Chemical wastes, *Farm wastes, *Livestock, *Water pollution sources, Missouri, Kansas, Runoff, Fertilizers, Pesticides, Waste disposal, Nitrates, Leaching, Salts, Associated costs, Eutrophication, Legal aspects, Social aspects, Nutrients, Bodies of water, Legislation, Federal government.
Identifiers: *Agricultural runoff.

Testimony was heard by the Senate Subcommittee on Air and Water Pollution, as part of its investigation into the effects of agricultural waste runoff on water. Agricultural operations in Kansas and Missouri are examined. Agricultural water pollution results primarily from surface runoff of silt, animal wastes, pesticides, fertilizers, and other chemical and biological agents. The problem of concentrated animal wastes from large-scale feedlots is explored. Current methods of controlling agricultural pollution, changes needed to correct current problems, and cost impacts are covered from the viewpoint of industry, science, and elected public officials. An extensive appendix includes articles and scientific papers relating to water pollution from agricultural runoff. Methods of curtailing and preventing the discharge of concentrated organic wastes into rivers and streams are explained. The contamination of surface water from plowing under concentrated feedlot manure is discussed. The contamination of water supplies by inorganic fertilizer salts is also examined. (Grant-Florida)

1108 - A2, A3, A4, C1

EFFECTS OF AGRICULTURAL LAND USE ON THE QUALITY OF SURFACE RUNOFF,
Tennessee Univ., Knoxville. Dept. of Agricultural Engineering.
J. I. Sewell, and J. M. Alphin.
Mimeographed paper presented at the Southeast Region Meeting of the American Society of Agricultural Engineers and Southern Section, Soil Conservation Society of America in Richmond, Virginia, February 14, 1972. 8 p, 3 tab, 7 ref. OWRR A-021-Tenn (1).

Descriptors: *Water quality, Feedlots, Lagoons, *Tennessee, *Farm wastes, On-site investigations, Water pollution sources, *Land use, Nitrates, Phosphates, Dissolved oxygen, Coliforms, Bacteria.

Surface water samples form twenty-four sites at four locations in Tennessee were analyzed to determine the effects of agricultural land use on the quality of surface runoff. The results showed that bacterial counts and chemical concentrations of surface water samples were dependent on land-use activities; however, the most important factors affecting the measured levels of these parameters were the location of the sampling points with reference to the source of the pollutants, dilution of the pollutants, and the time during the runoff cycle at which samples were taken. Concentrations of livestock increased the BOD, orthophosphates, and especially the bacterial counts of surface runoff samples from the areas affected. Of thirteen agricultural sites examined on flowing streams, none had dissolved oxygen or total nitrogen levels which failed to meet FWPCA standards for public water supplies, and only one site failed to meet the bacterial criteria.

1109 - B2, D4

AN EVALUATION OF AN ANAEROBIC LAGOON TREATING SWINE WASTES,
Mississippi State Univ., State College. Dept. of Civil Engineering.
James H. Scarborough.
Master's Thesis, August 1970. 92 p, 24 fig, 8 tab, 44 ref.

Descriptors: *Farm wastes, *Hogs, *Anaerobic digestion, Slurries, Confinement pens, Farm management, Waste treatment, Sampling, Biochemical oxygen demand, Chemical oxygen demand, Phosphate, Hydrogen ion concentration, Alkalinity, Nitrogen, Sedimentation, Water pollution sources, Odor, *Oxidation lagoons, Waste water treatment.
Identifiers: New-light swine farm.

Interest in the treatment of livestock wastes has grown in recent years due to concentration of livestock in areas where they are raised for commercial use and the migration to urban areas of those who are seeking a less polluted habitat. In Mississippi, an aerobic lagoon which treated swine wastes was studied for quality of incoming waste and effluent, as well as performance under varying temperatures. Random grab samples of influent and effluent were taken approximately once a week from February 10 to April 23, 1970, and again on May 19, 1970. The samples were studied for biochemical oxygen demand, chemical oxygen demand, phosphorous expressed as phosphate, volatile solids, total solids, most probable number of coliform bacteria per 100 ml, alkalinity, and total nitrogen. Results showed that anaerobic lagoons would reduce the pollutional characteristics of the waste considerably. The lagoon still contained an appreciable amount of oxygen demanding material and still caused highly odorous conditions, indicating that the effluent should receive further treatment. Perhaps anaerobic lagoons should only be used as a preliminary step rather than a complete treatment facility and should be followed by other means of treatment prior to the adequate and safe disposal of the effluents. (Atkins-Texas)

1110 - A3, A5, A9

LAKE TERMINOLOGY: WATER BLOOM,
Michigan State Univ., East Lansing.
J. O. Veatch, and C. R. Humphrys.
Bull Mich Agric Coll Exp Station, East Lansing, p 241, 1964. 1 fig.

Descriptors: *Eutrophication, Algae, Ducks, Color, Fishkill, Lakes, Odor, Toxicity, Water pollution effects, Water quality, Cattle.
Identifiers: *Definitions, *Water bloom, Toxic algae, Recreational use.

This lexicon of lake terminology defines a water bloom as: 'A prolific growth of plankton. A bloom of algae may be so dense that it imparts a greenish, yellowish, or brownish color to the water. The growth may be so concentrated in some parts of a lake that it interferes with swimming and boating. The algae not only imparts a disagreeable odor, but it may be a cause of fish mortality, and some species may be poisonous to cattle and ducks and a menace to drinking water supplies.' This entry includes an aerial photograph of an algal bloom concentrated in bay of a lake. (Eichhorn-Wis)

1111 - A3, A7, A9

POLYCHLORINATED BIPHENYLS,
David B. Peakall, and Jeffrey L. Lincer.
BioScience, Vol 20, No 17, p 958-964, September 1, 1970. 1 fig, 2 tab, 62 ref.

Descriptors: *Chlorinated hydrocarbon pesticides, *Food chains, *Pesticide toxicity, Physical properties, Chemical analysis, Persistence, Absorption, DDT, Chemical properties, Plastics, Paints, Rubber, Resins, Gas chromatography, Spectrophotometry, Mallard duck, Poultry, Songbirds, Wading birds, Mussels, Herrings, Path of pollutants, Water pollution sources, Water pollution effects.
Identifiers: *Biological magnification, *Aroclors, *Polychlorinated biphenyls, Chemical structure.

The structural and physical properties, uses, analytical methods, toxicology, levels in nature, and biological magnification of PCBs, and the ratio of DDT to PCB in the environment are summarized. Although nothing is known about the biological decomposition of PCBs, it is likely that they are more stable than DDT and its metabolites and thus have a tendency to accumulate up the food chain. No figures on the amount of these materials produced annually are available. Analysis of PCBs has been carried out by means of a combination of high resolution gas chromatography, and mass spectrometry. Nitration and saponification have been used to separate PCBs from other residues for analysis. Although several studies have been carried out on the toxicology of PCBs, toxic levels are still largely undefined. Studies have shown, however, that there are striking alternations in the internal organs of some mammals and birds. Data taken from several studies indicate that the PCBs are capable of biological magnification of the food chain. Because of the apparent danger of these materials it is necessary to discover the major sources of their escape into the environment. Sixty-two references have been cited in this summary. (Little-Battelle)

1112 - A2, C3, C4, C5

CATTLE FEEDLOT RUNOFF NATURE AND BEHAVIOR,
Kansas State Univ., Manhattan. Dept. of Bacteriology.
J. R. Miner, L. R. Bernard, L. R. Fina, G. H. Larson, and R. I. Lipper.
Proceedings, Industrial Waste Conference, 21st, May 3, 4, and 5, 1966, p 834-847. 9 fig, 9 tab, 10 ref.

Descriptors: *Water pollution sources, *Surface runoff, *Cattle, *Farmwastes, Rainfall intensity, Chemical properties, Bacteria, Nitrogen, Coliform, Streptococcus, Laboratory tests, Data collection, Analysis.
Identifiers: Feedlot.

Stormwater runoff is becoming recognized as an important water pollutant. Runoff from cattle feedlots is particulary strong. Three types of experiments were conducted to evaluate the characteristics and behavior of feedlot runoff. Two feedlots (0.05 acres each) were constructed, one with a dirt surface and the second with a concrete surface. Ten head of cattle were maintained in each lot and rainfall was simulated by a series of sprinklers. The runoff was collected and tested for chemical and bacteriel contamination. Tray experiments were conducted to determine bacteriological changes in manure lying on the feedlot surface. Anaerobic bottle studies were made to determine the effects of storage in deep ponds. Cattle feedlot produces a high strength waste with considerable quantities of nitrogen. Waste strength increased with low rainfall rates, warm weather and moist lot conditions. Runoff from the concrete surface lot was nearly twice as strong as from the unsurfaced lot. The bacterial nature of the stored feedlot runoff and litter changed continuously. Changes were a function of temperature and storage time. The fecal coliform: fecal streptococcus ratio does not appear to be an entirely reliable tool to identify the cause of an observed water pollution problem. (Goessling-Texas)

1113 - D4

AERATED LAGOON TREATMENT OF LONG ISLAND DUCK WASTES,
Cornell Univ., Ithaca, N.Y. Dept. of Civil Engineering; and Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
Raymond C. Loehr, and Dennis D. Schulte.
2nd International Symposium for Waste Treatment Lagoons, June 23-25, 1970, Kansas City, Missouri, p 249-258. 7 fig, 2 tab, 11 ref.

Descriptors: *Oxidation lagoons, *Farm wastes, Pilot plants, Chlorination, Phosphates, Mixing, Coagulation, Flocculation, Dissolved oxygen, Biochemical oxygen demand, Aerobic conditions, Anaerobic conditions, Cost analysis, Design criteria, Mathematical models, Waste water treatment.
Identifiers: *Aerated lagoons, *Duck wastes.

Laboratory treatability studies were conducted in 1965 to determine the feasibility of treating duck wastes in a number of treatment systems. Pilot scale tests were then run on a aerated lagoon system in 1967. The pilot plant had a 250,000 gallon capacity, an 8 ft depth, and a 5 HP floating aerator. 35% of the duck waste water systems subsequently installed provided in excess of 90% BOD reduction, and 50% provided in excess of 85% BOD reduction, with aerator power relationships ranging from .008 to .04 nameplate horsepower per 1000 gallons. These systems included aerated lagoons, settling ponds, and chlorination. Studies are presently being conducted on the new methods of phosphate removal, with some type of removal to be implemented as soon as possible.
(Lowry-Texas)

1114 - D4, F1

ANIMAL MANURE LAGOONS, A QUESTIONABLE TREATMENT SYSTEM,
Samual A. Hart.
2nd International Symposium for Waste Treatment Lagoons, June 23-25, 1970, Kansas City, Missouri, p 320-324. 1 tab, 19 ref.

Descriptors: *Farm wastes, *Oxidation lagoons, Organic loading, Infiltration, Evaporation, Percolation, Aeration, Oxygenation, Odors, Sprinkler irrigation, Aerobic conditions, Anaerobic conditions, Biochemical oxygen demand, Waste water treatment.
Identifiers: Aerated lagoons.

Both oxidation lagoons and oxidation ditches can be of significant value to the agriculture industry. First introduced in the early 1950's, these lagoons proved to be inexpensive to build and offer a minimum of maintenance. However, this system must be carefully designed in order to provide adequate treatment of agricultural wastes, and this care in design has not been inherent to lagoons in the past. Comprehensive field studies on cow manure have indicated that 60 ft to the third power of aerated lagoon volume is necessary to treat 1 lb BOD 5/day. In between totally mixed and aerated lagoons, and conventional oxidation lagoons are various degrees of anaerobic and aerobic treatment. Similar studies conducted on hog wastes fixed loading rates at 12 ft to the third power/400 lb pig as being capable of providing sufficient treatment. Oxidation lagoons were also studied, with loading rates of 30 ft to the third power/lb BOD5. Costs for the oxidation ditch treatment are $6 per hog of aeration equipment and $.006 per hog per day of power requirements. Overall, oxidation lagoons and ditches, and aerated lagoons can provide sufficient treatment if properly designed and maintained. (Lowry-Texas)

1115 - C3, D4, E3

CONTROL OF NITROGEN FROM ANIMAL WASTE WATERS,
Cornell Univ., Ithaca, N.Y. Dept. of Civil and Agricultural Engineering.
Raymond C. Loehr
Proceedings 12th Sanitary Engineering Conference on Nitrate and Water Supply: Source and Control, February 11-12, 1970, University of Illinois, Urbana: Illinois University, College of Engineering Publication, p 177-189, 1970. 13 p, 4 fig, 1 tab, 22 ref. FWQA Project WP-1493.

Descriptors: *Farm wastes, *Nitrogen compounds, *Waste treatment, *Nitrification, *Denitrification, Confinement pens, Farm lagoons, Organic wastes, Waste water treatment, Biodegradation, Aeration, Aerobic treatment
Identifiers: *Nitrogen removal.

The trend in recent years for the confinement feeding of livestock and for increased numbers of animals per production unit results in highly concentrated, low-volume waste flows which represent a pollutional hazard to ground- and surface waters. The pollutional contribution from these activities is manifested by excessive nutrient concentrations, chiefly high levels of nitrogen, microbial impairment of surface waters, release of contaminents that complicate subsequent water treatment operations, and depletion of dissolved oxygen in surface waters. Control of such wastes commences with containment. The microbial synthesis which occurs during containment reduces nitrogen levels to a certain extent. Further removals can be accomplished by ammonia stripping using diffused aeration or by nitrification-denitrification. The most suitable method of disposal for treated wastes is on the land, where the remaining nutrients can be incorporated into crops. (Knapp-USGS)

1116 - B1, D1, E1

MANAGING LIVESTOCK WASTES TO CONTROL POLLUTION,
Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.
James A. Moore.
Water Pollution by Nutrients--Sources, Effects and Control, Water Resources Research Center, University of Minnesota, Minneapolis, WRRC Bulletin 13, p 29-34, June 1969. 2 tab.

Descriptors: *Pollution control, *Organic loading, *Cattle, *Hogs, *Sheep, *Farm wastes, Water pollution sources, Water quality, Waste disposal, Minnesota, Nitrogen, Phosphorus, Potassium, Aerobic treatment, Water pollution control.
Identifiers: *Manure processing, *Manure disposal, Livestock industry, Manure storage, Oxidation ditch.

High costs and larger quantities of inert and biologically stable materials prohibit many municipal waste treatment systems being used for animal waste disposal. No system has been designed to remove nitrogen and phosphorus in animal wastes. Four steps in the management of manure are suggested: (1) collection, (2) processing, (3) storage, (4) utilization or disposal. Drying manure simplifies sanitation problems because it is stable, relatively odorless, and breeds few flies. Energy required for drying limits method. Anaerobic lagoons are a popular method for stabilizing organic matter, because disposal problems are mostly eliminated. Animal waste can be treated in aerobic oxidation ponds with oxygen supplied by algae and natural reaeration supplemented by mechanical aeration. Impervious-bottom tanks and storage areas should be considered to prevent nutrient leaching during extended holding periods. Although economically non-competitive, more effort to dispose animal waste as fertilizer would alleviate the problem and prove beneficial to soils. (Bannerman-Wisconsin)

1117 - A1, F4

WATER POLLUTION BY NUTRIENTS-SOURCES, EFFECTS AND CONTROL, PAPERS PRESENTED AT 1966 ANNUAL MEETING OF MINNESOTA CHAPTER SOIL CONSERVATION SOCIETY OF AMERICA.
Minnesota Univ., Minneapolis. Water Resources Research Center.
WRRC Bulletin 13, Minnesota Water Resources Research Center, June 1969. 79 p. OWRR Project A-999-MINN.

Descriptors: *Water pollution sources, *Water pollution effects, *Eutrophication, *Nutrients, Algae, Fish population, *Water pollution control, Farm wastes, Municipal wastes, Septic tanks, Recreation

wastes, Water quality.
Identifiers: *Nutrient sources.

The Bulletin includes the papers presented at a conference on 'Nutrient Pollution - Sources, Effects and Control' held in Minneapolis, Minnesota on January 8, 1969. The conference was planned as the Annual Meeting of the Minnesota Chapter, Soil Conservation Society of America. The papers, all individually abstracted, include the following titles: Nutrients and Other Forms of Pollution, Diagnosing Pollution in Lake Minnetonka, Effect of Eutrophication on Fish and Related Organisms, Health Aspects, Surface and Groundwaters, Animal Waste Disposal Problems and Trends in Minnesota, Managing Livestock Wastes to Control Pollution, Runoff and Sediment as Nutrient Sources, Controlling Nutrients and Organic Toxicants in Runoff, Treatment of Municipal Wastes, Septic Tank Effluents, Water Pollution in Recreational Areas - Sources and Control, and Setting Water Quality Standards and Regulating Nutrient Sources, Implementing Pollution Control.

1118 - A1, F4
WATER QUALITY MANAGEMENT PROBLEMS IN ARID REGIONS.
Robert S. Kerr Water Research Center, Ada, Okla. Treatment and Control Research Program.
James P. Law, Jr., and Jack L. Witherow, Editors. Federal Water Quality Administration Water Pollution Control Research Series 13030 DYY 6/69, October 1970. 105 p. FWQA Program 13030 DYY.

Descriptors: *Conferences, *Water quality, *Water pollution sources, *Water pollution control, *Arid lands, Irrigation, Agriculture, Evaporation, Salinity, Farm wastes, Surface waters, Groundwater, Planning, Irrigation effects, Wastes, Nutrients.

An international conference entitled 'Arid Lands in a Changing World' sponsored by the American Association for the Advancement of Science Committee on Arid Lands and the University of Arizona, was held at Tucson in June, 1969. The Federal Water Quality Administration provided financial support for the conference and solicited papers to be presented in the Water Management and Salinity and Desalinization sessions. This report presents a selected group of the papers presented at those sessions which should benefit those concerned with water quality management problems in arid regions. The title of the papers included in this report are as follows: nitrate removal from agricultural waste water; the effects of salinity standards on irrigated agriculture in the Colorado River basin; problems of pollution of irrigation waters in arid regions; water quality requirements and re-use of waste water effluents; salinity control in return flow from irrigated areas--a demonstration project; water quality control problems in inland sinks; natural pollution in arid land waters; distillation of waste waters: a water resource for arid regions; and animal waste runoff--a major water quality challenge. (Woodard-USGS)

1119 - B2, D4
TREATMENT OF AQUEOUS AGRICULTURAL WASTES FOR CLEAN WATER AND FOR MICROBIAL PROTEIN PRODUCTION,
Iowa State Univ., Ames. Dept. of Chemical Engineering.
G. T. Tsao. Iowa State Water Resources Research Institute, Ames, Completion Report ISW-RRI-33, Engineering Research Institute ISU-ERI, Ames-99959 April, 1971, 34 p. 27 fig. 12 ref. OWRR Project A-032-IA (6).

Descriptors: Oxygen, Absorption, *Foaming, *Aeration, *Cytological studies, Farm wastes, Waste water treatment, *Biological treatment.
Identifiers: Waldorf aerator, Cell growth, *Whey.

Cheese whey containing 35,000 ppm BOD is the most concentrated liquid waste that can be found in large quantities. It foams excessively when bubbled with gas. Cheese whey was successfully treated in a Waldhof aerator by Saccharomyces fragilis. This yeast can reduce about 85% of the BOD and produce single cell protein. A batch as well as a continuous growth process of this yeast was successfully developed. A fundamental study on the transient and steady state behavior of cell growth was also conducted. Through computer simulation, it was possible to predict growth pattern in batch and continuous processes. Oxygen is important in any aerobic biological process. The Waldhof aerator not only provides good aeration for yeast growth, but is also capable of handling highly foamy liquors like whey through its foam recycling mechanism. A sysmetical study on the working mechanisms of a Waldhof aerator was conducted. Foam fractionation of the yeast and other microbiological cells was also studied. Foam decay was found to follow a second-order rate pattern. A theoretical investigation was conducted on gas-liquid interfacial oxygen absorption. The effect of viable microbiological cells that consume the transferring solute on the rate of oxygen absorption was analyzed.

1120 - A3
SOURCES OF PHOSPHATE, AMMONIUM AND NITRATE CONTAMINATION IN SOME CENTRAL NEW JERSEY STREAMS,
Rutgers-The-State Univ., New Brunswick, N.J. Dept. of Soils and Crops.
Aytekin Bilgin.
M Sc Thesis, Rutgers University Graduate School, March 1971. 113 p, 29 fig, 7 map, 1 tab, 60 ref. OWRR Project A-027-NJ (1).

Descriptors: *New Jersey, *Water pollution sources, *Pollutants, *Phosphates, *Nitrates, Surface runoff, Leaching, Sewage disposal, Chemical wastes, Domestic wastes, Farm wastes, Industrial wastes, Fertilizers, Ammonia, Nitrogen cycle, Nutrients, Nitrification, Decomposing organic matter, Eutrophication, Balance of nature, Biochemical oxygen demand, Aquatic productivity.
Identifiers: *Middlesex County (N J), *Somerset County (N J), *Mercer County (N J), New Brunswick (N J), Princeton (N J).

A study was made from April to October 1970 of pollution in seven streams located in Middlesex, Somerset, and Mercer Counties, New Jersey. The objective of this investigation was to determine the origin, source, and concentrations of phosphate, ammonium, and nitrate polluting the streams. The following were the areas studied: Beaverdam Brook (E. Brunswick), Mile Run (New Brunswick), Six Mile Run (New Brunswick), Millstone River (Princeton), Rock Brook (Zion), Duck Pond Run (Princeton), and Big Bear Brook (Hightstown). Of these, Millstone River, located near a sewage disposal plant, and Mile Run, near a chemical plant, produced the highest phosphate and ammonia levels. Mile Run had the greatest BOD because of the heat and wastes polluting it. Nitrate contamination developed principally in areas where eutrophic conditions existed for some years, and where surface runoff leached out fertilizer residues from suburban lawns and cultivated agricultural soils. Moderate nitrate contamination was seen in Six Mile Run, Big Bear Brook, and Duck Pond Run. The highest nitrate level occurred in Beaverdam Brook where the adjacent watershed had been completely altered some 5 years earlier by bulldozing and grading operations. This activity completely destroyed the original soil profile and broke up and buried the former organic layer so that mineralization and nitrification was rapidly increased. (Glasby-USGS)

1121 - A3, A9, E1
WATER POLLUTION FROM LAND RUNOFF,
Agricultural Research Service, US Department of Agriculture.
K. C. Walker, and C. H. Wadleigh.
Plant Food Rev, Vol 14, No 1, pp 2-4, 1968. 3 p, 1 photo.

Descriptors: *Runoff, *Water pollution, Infiltration, Sediments, *Sediment yield, *Nutrients, Eutrophication, Inorganic compounds, Nitrates, Phosphates, Calcium, Magnesium, Fertilizers, Agricultural chemicals, Fishkill, Pesticides, Endrin, Irrigation, Acid mine water.
Identifiers: *Livestock wastes, Runnels, Feedlots, *Land runoff, Manure recycling, Bacterial pollution.

Contributions of agricultural activities to the pollution of runoff is surveyed, and it is found that sediment is by far the most prevalent entity that impairs water quality. Of the average annual precipitation, 30% becomes runoff and less than 1% infiltrates deeply. Sediment yield in the Mississippi basin averages 390 tons annually per sq mi. Large amounts of nutrients are lost with sediments. For example, the load per yr of nitrogen is 500,000 tons; phosphate, 750,000; calcium, 5,400,000; magnesium, 2,400,000, and livestock wastes, 1.6 billion (1965). Associated wastes brought the annual total to 2 billion tons. Organic waste problems are severe. 50,000 head of beef cattle produce as much waste as 600,000 people; therefore, serious economic and engineering planning is necessary for disposing of manure or for recycling it for fertilizer use. Major fish kills have occurred because of feedlot runoff, which with other farmland runoff contains high nitrates and phosphates. Pesticides usually are present but in low concentrations. Irrigation increases the natural salts content of runoff. Acid mine drainage is a problem in the Ohio River Watershed

1122 — A3, A4, C3
NITROGEN CYCLE IN SURFACE AND SUBSURFACE WATERS,
Wisconsin University, Madison.
S. Witzel, E. McCoy, O. J. Attoe, L. B. Polkowski, and K. T. Crabtree.
Water Resources Center, University of Wisconsin, Technical Completion Report, December 1968, 65 p. 14 tab., 12 fig., 27 ref.
1968. 65 p. 15 tab., 12 fig., 27 ref. OWRR Project B-004-Wis,

Descriptors:: *Domestic animals, *Wastes, fertilizers, *Essential nutrients, *Nitrification, crops, toxicity, soil porosity, irrigation, ground water, runoff, frozen ground, soil erosion, water pollution, Dentrification, phosphorus compounds, algae, aquatic plants.

Autotrophic and heterotrophic nitrification have been studied with 191 samples of shallow water from streams, farm ponds and adjacent soils. Of 47 chosen for repeated tests, 45 produced no sub 2-N ranging 5-154 microgram/ML. Av. 48 microgram/ML. Only 2 produced no sub 3-N at 33 and 46 microgram/ML. Of 167 stock cultures of soil fungi, the main producers were in the aspergillus flavus-oryzae and A. Wentii groups (75% yielded 65-100 micrograms of no sub 3-N) and the penicillum genus (21 of 24 species yielded 7-19 microgram/ML of no sub 3-N from no sub 2-N, not from organic N). Nitrifiers of no sub 2, no sub 3 type were found in 5 other genera. Residual no sub 3 following crop maturity migrates downward from 12 inches to aquifer depth at 20 feet over winter on waupun and plainfield soils, respectively. One Wisconsin community had 86 wells with 34.5% unsafe containing high no sub 3 and another had 550 wells with 1/3 unsafe. Surface waters received less than 5.7 lb. N and 2.53 lb. p. per A. in flood flows from a 1346 A. watershed; 3.62 lb. N and 1.14 lb. p per A. from 3 farm areas totaling 246 A. Lancaster plots receiving 15 tons dairy cow wastes per A. lost 19.8% more N and 11.3% more P when applied on frozen ground in a year of high winter runoff.

1123 - B1, D2, D4

A FEASIBILITY STUDY OF A LIVESTOCK WASTE DISPOSAL SYSTEM INVOLVING THE REUSE OF WATER,

North Dakota State Univ., Fargo.
George L. Pratt.
Research Project Technical Completion Report to Office of Water Resources Research, December 1968, Washington, D. C. 24 p, 11 tab, 2 ref. OWRR Project A-001-NDAK.

Descriptors: *Water reuse, Stock water, Domestic animals, *Farm wastes, Potable water, Solid wastes, Urine, Water pollution, Aeration, Aerobic treatment, Biological treatment, Coagulation, Filtering systems, Filtration, Flocculation, Oxidation, Waste storages, *Waste water treatment, Water purification, Water treatment.

Separating solid materials from liquid wastes that have been removed from a livestock barn can be accomplished in several ways. In trials at the North Dakota Agricultural Experiment Station settling tanks and sand filters were evaluated. In one phase of the work treatment of overflow from a settling tank that collected beef waste was emphasized. No treatment, aeration, and treatment with aluminum sulfate (alum) were tested for the settling tank overflow. The settling tank removed the bulk of the solids. Alum treatment of the overflow was effective in reducing total solids to the point where it was nearly feasible to provide final treatment. In the second phase of the work a slow sand filter was tested under controlled conditions to determine its adaptability for final treatment of reclaimed water. Tests were run at three temperatures, 45 deg F, 70 deg F, and 100 deg F. Controlled amounts of organic material were added to the influent of the filter. The filter was easily managed and adaptable to a wide range of conditions. Its performance was better at 70 deg F than at 45 deg F or 100 deg F.

1124 — A2, A4, E2

EFFECT OF VARIOUS FACTORS ON MOVEMENT OF NITRATE NITROGEN IN SOIL PROFILES AND ON TRANSFORMATIONS OF SOIL NITROGEN,

Wisconsin University, Madison.
R. J. Olsen.
University of Wisconsin, Water Resources Center, Report 1969. 79 p. OWRR B-004-Wis.

Descriptors: *Nitrification, *Soil nitrogen, *Public health, *Soil leaching, Groundwater, Soil profiles, Water table, Surface runoff, Farm wastes, Aerobic conditions, Incubation.
Identifiers: Lake Europhication, *Soil phosphorus, Alfalfa-Bromegrass, Spring thaws, Fertilizer-nitrogen.

There is increasing evidence that agriculture is contributing to the increase in nitrate-nitrogen in streams, lakes, and domestic water supplies. High amounts of nitrate-nitrogen in water are a health hazard and contribute to lake eutrophication. Methods by which nitrogen may enter the water from agricultural sources include the leaching of nitrate-nitrogen through the soil profile to the water table and surface runoff, especially during spring thaws from manure applied to frozen soil during the winter. The data obtained from field experiments indicate that pollution of groundwater with nitrate-nitrogen can be limited by avoiding excessive rates of fertilizer nitrogen; providing a crop cover on the soil during the growing season; use of hay crops, such as alfalfa-bromegrass, in rotation with corn or other crops receiving fertilizer nitrogen; and not permitting unprotected manure to accumulate during the time of year when leaching can occur. Recovery of fertilizer nitrogen by three successive corn crops and as soil in organic nitrogen following the last crop ranged from 73 to 88 percent. The average concentration of nitrate-nitrogen in the soil solution at the lowest profile depth sampled ranged from 14 ppm for virgin soils to 21 ppm for manure contaminated soils and to 33 ppm for cultivated soils. Rate of nitrification was directly related to the rate of manure application, presence of aerobic conditions, period of incubation, and soil phosphorus. The average recovery of nitrogen by chemical analysis of the soil receiving the higher manure rates after 37 weeks of incubation ranged from 24% for anaerobic conditions to 73 to 80 percent for the aerobic conditions. These data suggest that where animal manure is not to be used as a fertilizer, lagooning of the manure under anaerobic conditions may be an effective method of disposal with a minimum risk of water pollution. (Olsen - University of Wisconsin).

1125 - A3, F4

ANIMAL WASTE DISPOSAL PROBLEMS AND TRENDS IN MINNESOTA,

Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.
Evan R. Allred.
Water Pollution by Nutrients--Sources, Effects and Control, Water Resources Research Center, University of Minnesota, Minneapolis, WRRC Bulletin 13, p 22-28, June 1969. 2 fig, 3 tab.

Descriptors: *Livestock, *Wastes, *Farm wastes, Organic wastes, Minnesota, Biochemical oxygen demand, Farms, Pollutants, Water pollution sources, Eutrophication.
Identifiers: *Livestock waste disposal, Broiler farms, Livestock wastes comparison, Feedlots, Manure production, Food production wastes, Projected livestock farms, Wastes management.

The growing problem of animal waste disposal resulting from the trend toward concentration of livestock on fewer farms is discussed. Data compiled in Minnesota indicates large percentage of these farm animals are on feed and in confinement. The problem will accelerate as herds grow larger to meet future population demands. By 1980 there is a projected 10-fold increase in the average hog and feed-cattle herd size in Minnesota. Three reasons given for failure to solve animal waste disposal problems are: (1) reluctance to monetary expenditures on adequate methods, (2) because the problem has been considered unrelated to other parts of society, and (3) approaches have been used that are only applicable to other types of waste. Cost involved and the enormity of the problem are realized when data presented indicate a 250,000 bird poultry enterprise has a biochemical oxygen demand waste equivalent to a city population of 25,000. Eutrophication is increased by spreading manure on frozen ground and the consequent runoff in spring thaw. Since the cost of a treatment plant and storage is prohibitive to individual farmers, it is concluded that no immediate, simple solution is in sight. (Bannerman-Wisconsin)

1126 - A9

SAVANNAH RIVER ECOLOGY LABORATORY. ANNUAL REPORT, 1971.

Georgia Univ., Athens. Inst. of Ecology.
Robert J. Beyers, I. L. Brisbin, D. C. Coleman, J. B. Gentry, and J. W. Gibbons (editors). August 1971. Parts 1 and 2. 420 p. AT (38-1)-310.

Descriptors: *Boron, *Nutrient requirement, *Cycling nutrients, *Radioactivity effects, Water pollution effects, Ecosystems, Thermal pollution, Radioecology, Southeast U.S., Microorganisms, Bass, Ecology, Snakes, Poultry, Rodents, Aquatic habitats, Aquatic plants, Amphibians, Turtles, Aquatic life, Path of pollutants, Reservoirs, Streams, Soil-water-plant relationships, Absorption.

Work at the Savannah River laboratory is reported which includes basic ecology (16 projects), radioecology (3), ecosystem radiation effects (2), and thermal effects on fish (2). Analysis of southeastern United States surface waters for boron showed levels which were usually less than 100 ppb. It appears that a higher level in most streams is by leaching of rocks and soil, as compared with the lower level in large reservoirs which is comparable with the level in rainfall (except in cases of salt water intrusion). Other studies include: radiation effects on ecosystems involving (respectively) microorganisms, fish, and broiler chicks; and nutrient studies in ecosystems involving aquatic macrophytes, harvester ants, an old-field mouse, small mammals, snakes, mosquitofish, turtles, and lizards. (Bopp-ORNL).

1127 - A4, B1

WHY NITRATES IN WATER SUPPLIES,

G. E. Smith.
Hoard's Dairyman, Vol 110, No 18, p 1048-1049, September 25, 1965. 3 fig.

Descriptors: *Nitrates, Feed lots, Fertilizers, *Farm wastes, Missouri, Water supply, Water wells, Water pollution sources.
Identifiers: *Water contamination.

Studies show that 75% of Missouri's water is contaminated by nitrates, primarily from feedlots. Shallow wells are most affected, but deep ones can be if improperly cased. To solve the problem, new properly encased wells should be dug some distance from feedlots. (Marquard-East Central)

1128 - D4, E3

USE OF DUCKWEED FOR WATER TREATMENT AND ANIMAL FEED,

Louisiana State Univ., Baton Rouge. School of Forestry and Wildlife Management.
D. D. Culley, Jr., and E. A. Epps.
Journal Water Pollution Control Federation, Vol 45, No 2, p 337-347, February, 1973. 1 fig, 5 tab, 28 ref.

Descriptors: *Farm wastes, Waste water treatment, Farm lagoons, Nutrient removal, Feeds, Livestock.
Identifiers: *Duckwood, Lemnaceae.

This scientific study was established to search for aquatic plants suitable for nutrient reduction in animal waste lagoons and for utilization in animal feeds. Criteria for evaluating the aquatic plants are given. Chemical composition of plants from the family lemnaceae are shown in tables based on eight test sites. Duckweed shows great potential, but minor problems include toxic buildup and excess water content. (Marquard-East Central)

1129 - A3, B2, C2, D2

BEEF CATTLE FEEDLOT RUNOFF, SOLIDS TRANSPORT AND SETTLING CHARACTERISTICS,

Nebraska Univ., Lincoln.
C. B. Gilbertson, J. A. Nienaber, T. M. McCalla, J. R. Ellis, and W. R. Woods.
Transactions of the ASAF (American Society of Agriculture Engineers), Vol 15, No 6, p 1132-1134, 1972, 6 fig, 8 ref. Support in part by EPA.

Descriptors: *Feed lots, Runoff, Continuous flow, *Farm wastes, Cattle, *Waste water treatment.
Identifiers: *Solids removal systems, Batch system.

Removing settleable solids from beef cattle feedlot runoff requires a working knowledge of the relationships between precipitation, runoff, solids, transport, and settling of the transported solids. The authors give physical descriptions of the working area and develop estimating equations which can be used to assist in design of solids removal systems in geographic areas with similar climatic and feedlot conditions. Two systems, a 'batch system', and a 'continuous flow' system, were constructed. In laboratory tests (Imhoff cone tests), about 40% of the total solids transported (by weight) settled in 16 to 18 minutes at zero velocity of flow. Calculated bulk density of settleable solids was 6.71 lb. per cu. ft. with a standard deviation of 3.69 lb. per cu. ft. It was recommended that an open channel should be equipped with barriers to restrict runoff flow to near zero velocity to remove sufficient solids to maintain a satisfactory condition within the holding pond. (Wetherill-East Central)

1130 - D2, E3
THE OPCCO DRYER.

Agricultural Engineering, Vol 53, No 6, p 16-17, June, 1972. 2 fig.

Descriptors: *Recycling, Drying, Fertilizers, *Farm wastes, *Waste treatment, Poultry, Feeds.

A solid waste management system, developed and patented by Harvey Wenger and manufactured by Organic Pollution Control Corp., has been placed on several large poultry farms to turn poultry litter into fertilizer or into a feed additive for livestock. Michigan State University's Dr. Howard Zindel and other experts feel that the dryer, used so far primarily with poultry manure, can successfully handle all forms of animal wastes plus packing house offal, vegetable and fruit peel and pulp, and municipal sewage. Requiring an area of about 20-40 feet, the 40 ton per day unit operates on either natural or LP gas. Plans for developing other power supplies are being studied. The drying process is described and a schematic of the flow path is shown. The process is not inexpensive, but it does supply a solution to the waste problem. (Wetherill-East Central)

1131 - B1, C5
FIVE FEEDING SYSTEMS COMPARED.
Feedlot Management, p 34-37, January, 1971. 8 fig.

Descriptors: *Feed lots, Performance, Runoff, *Farm wastes, Cattle, Confinement pens.
Identifiers: Animal density, Open lot, Open shed, Cold barn, Warm barn.

Preliminary results are given on the influence of various housing systems on beef cattle and the effect of animal density on feedlot performance. It is indicated that housed confinement should be used to capacity and maintained year round for maximum benefits. Housed confinement tends to control illness and high density does not seem to jeopardize health or feed efficiency. Advantages and disadvantages are given for each type of housing studied. The five types of housing are open lot, open shed, manure pack shed, cold barn and warm barn. All five systems are designed to contain all animal wastes. (East Central)

1132 - F4
THE GREAT MANURE DILEMMA,
J. Gerstner.
The Furrow, p 1-2, September/October, 1970.

Descriptors: *Waste disposal, Waste treatment, Recycling, *Farm wastes, Livestock.

Disposing of animal wastes cheaply and without pollution is fast becoming one of agriculture's knottiest problems. United States livestock produce about two billion tons of liquid and solid wastes per year, enough to fill a square mile 10 feet high every day. Complicating the state of overproduction is the development of cheap commercial fertilizer. The large differences in livestock operations make one ultimate solution to manure handling doubtful, if not impossible. The characteristics of manure change with the type of animal, feed, and climate. The requirements for practical disposal vary with the operation's size, location, and amount of land available. Some methods being developed are: feeding processed manure to livestock, burying effluent, spreading and deodorizing it, and selling it. The animal waste problem is likely to prove less technical than economic. (Wetherill-East Central)

1133 - A1, B1, F2
POLLUTION CRACKDOWN.
The Furrow, p 4. September/October, 1970.

Descriptors: *Feed lots, *Regulation, Waste disposal, Recycling, *Farm wastes, Legal aspects, Livestock.

Cattle feeder George Reynolds was one of many stockmen forced to move farther away from expanding city limits. Many, like James Sinning, have faced law suits as high as $90,000 from people who moved next door after their feedlots had been established. Some stockmen are working with authorities to prevent embarrassing or costly law suits in the future. Lawsuit tips. Locate feedlots away from neighbors and streams. Ag engineer E. H. Davis says, 'Try to make friends with your neighbor, so you understand his problems and he understands yours.' (Wetherill-East Central)

1134 - D3, E3
FEED 'EM TRASH, CUT POLLUTION.
Beef, p 12. July, 1971.

Descriptors: Cellulose, Brush control, *Farm wastes, *Recycling, Proteins, *Feed lots, Texas, Feeds.

Texas Tech researchers have devised a process that takes paper, manure, brush, or any substance with cellulose and converts it to protein and sugar. The product can be used for animal feed and possibly in the future for human consumption. (Marquard-East Central)

1135 - A3, B1
ENGINEER SAYS FEEDERS CAN HANDLE MOST POLLUTION CONTROL PRACTICES.

Beef, p 15. July, 1971.

Descriptors: *Feed lots, Runoff, *Farm wastes, Water pollution control, Nebraska.

75% of feedlot pollution problems can be controlled by the individual. Small operators can receive help from the Soil Conservation Service while large operators must go to engineers to solve the other 25%. Nine suggestions are offered for control of runoff. (Marquard-East Central)

1136 - B2, D4
FEEDERS HEAR WOES OF CONFINEMENT START.

Beef, p 16-17. July, 1971.

Descriptors: Ammonia, Feed lots, Waste storage, *Farm wastes, Oxidation, Proteins, Iowa, *Oxidation lagoons, Waste water treatment, Livestock.

Problems of an oxidation ditch at Iowa State University are described. Because the start-up period was during the winter, ammonia foam resulted. Later, equipment malfunctions, protein foam, and freezing of sewage created problems. How each problem was met, is described. (Marquard-East Central)

1137 - A2, B2, F2
REGISTRATION IS REQUIRED AS GOVERNMENT MOVES TO CONTROL WATER POLLUTION FROM LARGE FEEDLOTS,
J. Richter.
Beef, p 20. July, 1971

Descriptors: *Feed lots, *Waste disposal, Farm wastes, Legal aspects, Water pollution control.
Identifiers: *Registration.

As of July 1, 1971, feedlots with over 1,000 head must apply for permits to discharge effluents into waterways. Smaller units, those that don't discharge from a single point source, or those that are in states of tougher control do not have to register. Agencies involved are the EPA and the Army Corp of Engineers working with the Refuse Act of 1899. (Marquard-East Central)

1138 - B1, C5, E2
HOUSED CONFINEMENT - AN ANSWER FOR FEEDING IN NORTHERN CALIFORNIA,
E. W. Manthey.
Feedlot Management, Vol 14, No 2, p 10-16, February, 1972. 6 photos, 1 fig.

Descriptors: *Feed lots, *Waste disposal, *Farm wastes, California, Confinement pens, Cattle.
Identifiers: Cow toilet.

Physical facilities are described and pictured for a housed feedlot that takes advantage of northern California's market and feed supply and overcomes the problem of the wet season. Construction time/cost are cut by new methods of casting concrete slotted floors in place. The pit beneath the lot is scraped continuously by a cable driven blade and disposed of on 160 acre fields by sprinkle irrigation. Rain runoff and overflow of troughs are piped to a pond. (Marquard-East Central)

1139 - B1
HOW WEATHER AFFECTS FEEDLOT PERFORMANCE.

Feedlot Management, Vol 13, No 2, p 38-39. February, 1971.

Descriptors: *Mud, *Rain, *Winds, *Feedlots, Farm wastes, *Weather effects, Winter, Productivity.
Identifiers: Shelter.

Studies were made of weather factors associated with winter as possible causes of reduced feedlot performance. Tests were performed under artificially produced conditions. Mud was the most serious cause of reduced production. Rate of gain was reduced and the amount of feed required increased. Artificial areas are described and resulting data are given. (Fomby-East Central)

1140 - D2, E3
ANOTHER POSSIBLE PROCESS FOR MANURE.

Calf News, Vol 11, No 1, p 38, January 1973

Descriptors: Feedlots, Farm wastes, *Waste treatment, Fertilizers, Ammonia.

A theory has been developed for the processing of manure which could produce 1,000 tons of ammonia per day from the manure deposits of around 600,000 cattle. This theory proposes that the manure be partially oxidized in the presence of the correct amount of air so that a synthetic gas is produced in the correct ratios to be used for ammonia production. By this process, the manure would be converted into an easily transported fertilizer which then would go back to the land to insure high crop yields. This process may also prove an answer to the problem of cattle feedlot pollution. (Anderson-East Central)

1141 - A4, A9, C3

NITRATES DANGER FOR HUMANS, TOO,
J. E. Grundman.
Missouri Ruralist, p 24-25, February 27, 1965.

Descriptors: Feed lots, *Water wells, *Nitrates, *Farm wastes, *Missouri, Water pollution sources.
Identifiers: Nitrate cyanosis.

Nitrate contamination of well water in Missouri has been recognized in recent years. Although sampling is incomplete and data not totally conclusive, nitrate pollution appears to be closely linked with proximity to feed lots and livestock wastes, silo drainage, manure piles, and septic tanks. Infants not yet consuming solid foods are subject to nitrate cyanosis from the intake of high-nitrate water in feedlot areas. A high nitrate content also accounts for a number of maladies in livestock. Suggestions for combating nitrate pollution are given. (Anderson-East Central)

1142 - A6, A9, B1, C5

WASTE-CAUSED AIR POLLUTANTS ARE MEASURED IN SWINE BUILDINGS,
Illinois Univ., Urbana. Agricultural Experiment Station.
D. L. Lebeda, and D. L. Day.
Illinois Research, p 15, Fall, 1965.

Descriptors: Ventilation, *Farm wastes, *Feed lots, Air pollution, *Hogs.
Identifiers: *Tolerance levels, Gas concentrations, Threshold levels.

The practice of collecting swine waste under partially or totally slotted floors has created a need to discover what pollutants are produced and to determine the tolerance levels of the swine to these pollutants. Untreated ponded swine wastes could hypothetically be expected to produce the same gases that untreated municipal waste creates under anaerobic conditions. A study was undertaken to determine the concentrations of ammonia, hydrogen sulfide, carbon dioxide, and airborne bacteria, with and without forced ventilation, in swine buildings with fluid manure. None of the gas concentrations approached the threshold levels for human occupancy, and research is now being planned to determine the tolerance levels of swine. (Dudley-East Central)

1143 - A5, B1, C3

A LOVELY NEW SCENT FOR MANURE.
Calf News, Vol 9, No 10, p 4. October, 197.

Descriptors: *Air pollution, *Sagebrush, *Farm wastes, Odor, Water pollution control.

A method of reducing manure odor with a sage brush food additive has been discovered. This additive, which causes continuous production of volatile oils in manure and urine, seems to improve the health of the cattle with no detectable change in the taste of the beef. Plans for future research include spraying of feedlots with sage oils. The oils can be synthetically produced, but there is an abundance of natural sage. The product is not yet commercially available. (Fomby-East Central)

1144 - B1, C5

CONFINEMENT FEEDING - PROS, CONS, AND TIPS,
Illinois Univ., Urbana.
D. G. Jedele.
Feedlot Management, Vol 13, No 1, p 21-23. January, 1971.

Descriptors: Runoff, Water pollution, Air pollution, Performance, *Feedlots, *Farm wastes, Illinois, *Confinement pens.

Advantages and disadvantages of confinement feeding are described. Aspects the feeder should investigate before beginning construction of confinement buildings are discussed. (Fomby-East Central)

1145 - E3

FEED RECYCLING SHOWING PROMISE.
Calf News, Vol 11, No 1, p 28-29, 52, January 1973.

Descriptors: Feed lots, *Farm wastes, *Recycling, *Feeds, Equipment, California, Foods.

This is a progress report on the Feed Recycling Company, a company selling equipment that takes manure from feedlots and converts it into feeds. The equipment is capable of converting a ton of manure into sugars, fibers, and 400 pounds of protein. Initial cost for the unit is $100,000 and operating costs are five dollars a ton. The end product is worth thirteen cents a pound, which could mean returns up to $600,000 a year for wastes from a feedlot. Feeding tests for the feed are now being run at a California research station. (Marquard-East Central)

1146 - B3, C5, E3

FEEDLOT WASTE UTILIZED EFFICIENTLY BY ANIMALS.
Oklahoma State Univ., Stillwater.

Agriculture at OSU, Summer, 1972, 1 p.

Descriptors: *Farm wastes, Sheep, *Feed lots, *Proteins.
Identifiers: *Digestibility.

Feedlot dry wastes from an open feedlot were fed to sheep. Though the wastes were high in digestible protein and nutrients, a potential hazard is the entry of toxic materials into the human food chain. These first tests were limited and need to be repeated more thoroughly before any recommendations will be available. (Lee-East Central)

1147 - A1, B1, D1, E1, F1

SOLID WASTE MANAGEMENT FOR CATTLE FEEDLOTS,
Texas A and M Univ., College Station. Dept. of Agricultural Engineering.
J. M. Sweeten, W. S. Allen, and D. L. Reddell.
Cattle Feeders' Information, Publication No L-1094, (1973), 4 p.

Descriptors: *Solid wastes, *Storage, *Ultimate disposal, Groundwater, Pollutants, Aquifers, *Waste water treatment, Fertilizers, *Feed lots, Cattle, Farm wastes.

Information is presented for commercial cattle feedlots on methods and costs of solid feedlot waste management; equipment selection guidelines; and agronomic effects of applying feedlot manure to cropland. (Lee-East Central)

1148 - A4, B2, D4

DAIRY WASTE PONDS EFFECTIVELY SELF--SEALING,
Agricultural Research Service, Riverside Calif. Soil and Water Conservation Research Div.
S. Davis, W. Fairbank, and H. Weisheit.
Paper presented at 1972 Annual Meeting, American Society of Agricultural Engineers, Hot Springs, Arkansas, June 27-30, 1972, Paper no 72-222, 10 p, 2 tab, 1 fig, 10 ref.

Descriptors: Groundwater pollution, Farm wastes, *Infiltration rates, *Farm lagoons, Sewage ponds, *Sealing, Cattle, Dairy Industry.

Infiltration rates of contaminated water from manure ponds are discussed. Infiltration rates of a dairy waste pond were measured with irrigation water before manure water was applied. Infiltration decreased from 48 inches per day with clean water to 0.2 inches per day with manure water after 4 months. (Lee-East Central)

1149 - A2, B2, E2, F1

MANURE SLURRY IRRIGATION SYSTEM RECEIVING LOT RUNOFF,
Tennessee Univ., Knoxville. Dept. of Agricultural Engineering.
J. I. Sewell.
Paper presented at 1972 Annual Meeting, American Society of Agricultural Engineers, Hot Springs, Arkansas, June 27-30, 1972, Paper no. 72-443, 13 p, 7 fig, 5 ref.

Descriptors: *Pollution abatement, Runoff, Groundwater, *Slurries, Irrigation systems, *Cattle, Farm wastes, Waste disposal, Management, Feed lots.

Plans for facilities and system design for a manure slurry irrigation system are presented. This system consisting of a storage tank, chopper-agitator-pump unit, flush pits, irrigation pipe and a large sprinkle performed durably in testing and offered possibilities for improved efficiency in manure management. It created a minimum of pollution problems. The operational plans and system costs are outlined. (Fomby-East Central)

1150 - B1, C5, D1, F1, F2

OBSERVATIONS OF DAIRY MANURE HANDLING SYSTEMS,
Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.
D. W. Bates.
Paper presented at 1972 Annual Meeting, American Society of Agricultural Engineers, Hot Springs, Arkansas, June 27-30, 1972, Paper No 72-413, 3 p.

Descriptors: *Waste disposal, *Waste storage, *Farm wastes, Waste treatment, Cattle, Dairy industry.
Identifiers: Stall barn, Stacking system, Bedding, Solid alleys, Slatted alleys, Liquid manure systems.

Because of the need to reduce labor in handling manure, the cost of bedding, and regulations dealing with the handling and disposition of animal manure, old manure disposal methods are being replaced by new. Various systems for the daily hauling will depend somewhat on whether the farmer has a stall barn or free-stall barn. Slatted or solid alleys, automatic scrapers, and a new manure pump which forces manure from a collection point in the barn through a pipe to an external manure pit for storage and later removal are discussed. Storage capacity is an important facet for dairymen, particularly in the colder regions of the country. Advantages of figuring construction costs prior to building, and disadvantages of 'adding on' are discussed. (Dudley-East Central)

1151 - A6, A9, B1

IMPROVED BEEF CONFINEMENT FACILITIES THROUGH PIT VENTILATION AND TEMPERED AIR INTAKES,
Northern States Power Co., Minneapolis, Minn.
M. Nabben.
Paper presented at 1972 Annual Meeting, American Society of Agricultural Engineers, Hot Springs, Arkansas, June 27-30, 1972, Paper No. 72-449, 7 p.

Descriptors: *Ventilation, *Farm wastes, *Viruses, Animal diseases, Cattle.
Identifiers: Fogging, Velometer test.

The high incidence of virus pneumonia in animals with cough problems in a feeder beef cattle herd prompted the owner and veterinarian to seek the cause and solution. They believed that the ventilation system (which is described in detail) was the main factor causing illness. The air flow patterns in the building were rearranged; exhaust fans were installed to remove gases created in the liquid manure pit; and electric heaters were installed in every fresh air intake to eliminate fogging. Before these changes were made, there was a 10% death loss of cattle and frequent visits were made by the veterinarian. After the changes were made (during the 1971-72 winter), there were no deaths nor veterinarian trips. (Dudley-East Central)

1152 - B1, D4

PERFORMANCE OF BEEF ANIMALS AS AFFECTED BY CROWDING AND THERMAL ENVIRONMENT DURING A FALL-WINTER PERIOD,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
G. W. A. Mahoney, A. F. Butchbaker, and J. I. Fryrear.
Paper presented at 65th Annual Meeting, American Society of Agricultural Engineers, Hot Springs, Arkansas, June 27-30, 1972, Paper No, 72-426, 18 p, 5 fig, 1 tab, 6 ref.

Descriptors: Production, Cattle, Windbreaks, *Oxidation lagoons, *Waste water treatment, *Farm wastes, Productivity, Feeds.
Identifiers: Crowding, Slotted floors, Weight gain.

Results of feed trials made in fall-winter periods of 1969-1972 are reported. The objectives of these trials were: (1) Compare production and feed consumption for 3 levels of crowding, (2) Compare production and feed consumption rates for cattle on slotted floors with wind breaks and shades with cattle in open cattle pens, (3) Determine performance of a cattle waste oxidation ditch for fall-winter operation in the Southwest. Corresponding results were: (1) Maximum gains and feed efficiency were obtained at approximately 20-22 square feet per animal. (2) Weight gain of cattle on slotted floors was not significantly greater than those in open pens, (3) Cold weather freezing indicated that enclosure of oxidation ditches might be necessary for their effective use in the Southwest. (Marquard-East Central)

1153 - B1, C5

MATHEMATICAL SIMULATION OF ENERGY METABOLISM IN BEEF ANIMALS,
Oklahoma State Univ., Stillwater.
M. D. Paine, J. A. Witz, A. F. Butchbaker, C. M. Bacon, and J. E. McCroskey.
Paper presented at 1972 Annual Meeting, American Society of Agricultural Engineers, Hot Springs, Arkansas, June 27-30, 1972, Paper No. 72-510, 25 p, 8 fig, 2 tab, 26 ref.

Descriptors: *Feed lots, *Mathematical models, *Energy, Systems analysis, Farm wastes, Cattle, *Animal metabolism.
Identifiers: Bioenergetics.

A mathematical model is presented that determines the amount of energy gained and lost in a feedlot situation by using a systems approach. Validation of the complete model indicated that more experience with model parameters will be necessary. However, the model did show potential for making valid estimates of animal growth and feed consumption. Possible applications of the model are demonstrated and discussed. Figures and tables list feedlot variables considered and predictions vs. experimental data in determining the validity of this mathematical model. (Marquard-East Central)

1154 - B1, C5

WINTER AND SUMMER SHELTER FOR BEEF CATTLE IN LOUISIANA,
Louisiana State Univ., Alexandria. Dean Lee Agricultural Center.
J. Pontif, W. A. Nipper, A. F. Loyacano, and H. J. Braud.
Paper presented at 1972 Annual Meeting, American Society of Agricultural Engineers, Hot Springs, Arkansas, June 27-30, 1972, Paper No 72-425, 23 p, 6 fig, 7 tab, 6 ref.

Descriptors: *Feed lots, *Farm wastes, *Louisiana, Windbreaks, *Climates, Cattle, Feedlots.
Identifiers: Shelters, Fans.

The purpose was to learn what advantage in feedlot performance of fattening cattle could be attributed to winter shelter and summer shade and fans under Louisiana feedlot conditions. Experimental procedures are detailed. Findings are reported in figures and tables. It was found that (1) winter roofs did not improve gain, (2) windbreaks were detrimental to daily gains because they prevented drying of wet floors, (3) fans did not increase gains, and (4) summer shades were most beneficial in promoting gains. (Marquard-East Central)

1155 - C1

THE FATE OF SOLUBLE MUCHIN IN THE GASTRO-INTESTINAL TRACT OF SHEEP,
Cambridge Univ. (England). Dept. of Veterinary Clinical Studies.
J. F. Hecker.
Journal of Agricultural Science, Vol 80, p 63-69, 1973, 4 tab, 40 ref.

Descriptors: *Nitrogen, *Sheep, Enzymes, Hydrolysis.

Identifiers: *Soluble mucins, *T.C.A.-soluble mucin, Rumen liquor, Caecal liquor, Faecal liquor, Gastro-intestinal tracts, Fucose, Rhamnose, Hexose, Methyl pentose, Histology.

The fate of soluble mucins in the gastro-intestinal tract of sheep was determined. Incubation of a soluble mucin with liquor from large intestinal contents resulted in loss of mucin. Some of this loss was due to soluble enzymes. The loss of mucin was less when incubation was with rumen liquor and varialbe when with ileal liquor. The mean amounts of nitrogen in a soluble mucin fraction which was soluble in trichloroacetic acid (T.C.A.-soluble mucin) were 2.5, 7.3, and 20.0 mg per 100 ml in rumen, caecal and faecal liquors respectively. These amounts were only a small proportion of the total soluble nitrogen in these fluids. Amounts of T.C.A.-soluble mucin, measured by sugar content, were greatest in contents from the small intestine. When the amounts of T.C.A.-soluble mucin were compared with the amounts of lignin in the samples, there was an increase between the abomasum and the first part of the small intestine and than a decrease to the caecu. Amounts relative to lignin were low in other parts of the gastro-intestinal tract. The liquors was in ileal liquor. The presence of the methyl pentoses, fucose and rhamnose indicates that the T.C.A.-soluble mucin is derived from mucus and bacteria. (East-Central)

1156 - A2, C5, E1

SEEPAGE LOSSES AND FERTILIZER PRESERVATION IN MANURE STACKING PRACTICE,
Wisconsin Univ., Madison. Dept. of Agricultural Engineering.
T. S. Hsu, C. O. Cramer, and J. C. Converse.
American Society of Agricultural Engineers, Paper No. 72-442, 1972. 23p, 8 tab, 11 fig., 15 ref.

Descriptors: *Seepage, *Farm wastes, Cattle, *Solid wastes, Organic matter, *Nutrients, Nitrogen, Physical properties, Chemical properties, Volatility, Degradation (Decomposition), Dairy, *Waste disposal, *Waste storage, Wisconsin, Biochemical oxygen demand, Chemical oxygen demand.
Identifiers: *Manure stacking, Bedding, Steam distillation method.

A model study of manure stacking using a 3x3 factorial design with two replicates was conducted to determine the effect of type and amount of bedding on seepage losses, manure degradation and volumes. Corn stalks and oat straw were utilized in the experiment at 3 levels: (1) the control (no bedding), (2) the addition of 1.5 lb. of bedding material per 60 lb of fresh manure, and (3) the addition of 3.0 lb. of bedding material per 60 lb. of fresh manure. The following conclusions were reached: the addition of bedding material to fresh manure decreases the losses of organic matter, solids, and nutrients in the seepage from the manure stacks; corn stalks significantly reduce the losses of seepage and nitrogen, COD, BOD, and solids in the seepage while oat straw does not; a high percentage of organic matter, nutrients and solids are preserved in the stacks; and higher quantities of BOD5, COD, solids, and nutrients were lost in the seepage from the stacks with a lower level of treatment before the freezing period and immediately after the spring thaw. Experimental procedures and results are outlined. (Dudley-East Central)

1157 — B1, D1, E1, F2, F4

CANADA ANIMAL WASTE MANAGEMENT GUIDE,
Canada Committee on Agricultural Engineering.
Canada Animal Waste Management Guide. Canada Animal Waste Management Guide Committee under the authority of Canada Committee on Agricultural Engineering, 57 p, 1972, 9 tab., 4 fig., appendices.

Descriptors: *Farm wastes, *Livestock, *Production, *Design, *Management, Pollution, Manure utilization, Nitrogen, Farm lagoons, Aerated lagoons, Aerobic treatment, anaerobic digestion, *Waste storage, *Waste disposal, Dehydration, Incineration, Zoning, Regulations, Legal aspects, Equipment, Fertilizers, Canada.
Identifiers: *Canada legislation, Dead bird disposal, Composting.

Current Canadian practices which provide reasonable approaches to handling animal wastes were compiled with particular emphasis on using the land as a recycling system. Detailed information is given for (1) manure management, (2) utilization of manure in crop production, (3) site selection, zoning and building construction of manure handling systems, and (4) processing of animal wastes. Relevant legislation on animal waste management in each province and addresses of equipment manufacturers are also included. (Dudley - East Central).

1158 - A2, B2, E2

DO YOU HAVE TO MOVE 'EM OR CAN YOU LEAVE 'EM,
Agricultural Research Service, Lincoln, Nebr.
N. Swanson.
Nebraska Farmer, p 13, 15, February 3, 1973, 1 fig.

Descriptors: *Feed lots, Runoff, *Waste storage, *Waste disposal, *Water pollution control, *Irrigation systems, Flood protection, Dikes, Sumps, Basins, Nebraska, Cattle.
Identifiers: SCS Rural Environmental Assistance Program.

By using help from government agencies, it is possible to control runoff from feed lots which previously might have had to relocate. As an example, the Soil Conservation Service and agricultural engineers developed a dike system for a problem feedlot on the banks of a stream. The dike prevents runoff and floods and provides weather protection for the cattle. A basin collects the runoff which is then pumped into a sump and then the water is disposed of by irrigation. The solids are spread across the top and slopes of broad-basin terraces or mounded in the feedlot. (Marquard-East Central)

1159 - B1, D1, E1

METHODS OF SWINE MANURE DISPOSAL,
Illinois Univ., Urbana.
A. J. Muehling.
In: Oregon State University, Corvallis, Agricultural Experiment Station, Special Report 316, p 10-13, December 1970.

Descriptors: *Farm wastes, *Management, *Waste disposal, *Hogs, Lagoons, Irrigation, Waste treatment.
Identifiers: Solid floors with bedding, Slotted floors.

Due to new anti-pollution laws, swine producers are compelled to plan ahead before enlarging or building new facilities for their swine. Guidelines for planning such facilities are accompanied by descriptions of the following manure handling systems: (1) solid floors with bedding - store and haul, (2) slotted floors - store and haul, (3) slotted floors - combination of lagoon and hauling, (4) slotted floors - oxidation ditch-lagoon, (5) flushing gutter-lagoon-irrigation. (Dudley-East Central)

1160 - A2, C2, C3, C4, C5

CHARACTERISTICS OF CATTLE FEEDLOT SURFACE RUNOFF,
J. C. Ward, E. M. Jex, and T. E. Norton.
Typescript, (1970), 4 p, 1 tab.

Descriptors: *Feed lots, *Surface runoff, Dissolved solids, Biochemical oxygen demand, *Cattle, Conductivity, Hydrogen ion concentration, Water pollution sources.
Identifiers: Volatile solids, Van't Hoff-Arrhenius relationship, Onsager equation.

This study has two parts: (1) the complete mixing of cattle manure with distilled water to obtain characteristics of the manure, and (2) examination of surface runoff samples from cattle feedlots in order to ascertain their characteristics as a function of several hydrologic variables. In part 1, the supernatant from samples was examined for conductivity, pH, dissolved solids, volatile solids, and BOD. In part 2, a simulated rainfall apparatus was utilized to obtain runoff samples. These samples were analyzed on the spot and in the laboratory for ultimate BOD, conductivity, alkalinity, settleable suspended solids, volatile solids, and dissolved solids. (Dudley-East Central)

1161 - A9

COMMON MISUNDERSTANDINGS ABOUT HEATED DISCHARGES,
Federal Water Pollution Control Administration, Southeast Region, Atlanta, Ga.
C. B. Wurtz.
In CLEAN WATER FOR THE NATION'S ESTUARIES, Transcript of Public Meeting, Biloxi, Mississippi, January 17, 1968, p 4.

Descriptors: *Hydroelectric plants, *Heated water, *Ecology, *Aquatic animals, *Thermal pollution, Predation, Pathogenic bacteria, Physiological ecology, Animal metabolism, Animal parasites, Water quality, Bacteria, Electric powerplants, Engineering structures, Industrial plants, Structures, Powerplants, Afterbays, Spawning, Wildlife, Dissolved oxygen, Fish, Animals, Aquatic life, Food chains, Water types, Fisheries, Public health, Microorganisms, Plants.

The author describes five common misunderstnadings about the effects of heated discharges on aquatic life. These misunderstandings relate to the belief that an increase in water temperature will: (1) Cause a reduction in the capacity of the water to retain dissolved oxygen. (2) Cause a deterioration in the 'quality' of the biological community, i.e., less desirable species of organisms will replace more desirable species. This is usually argued as an increase of only two or three degrees without any scale being mentioned. (3) Cause fish to spawn earlier, and at a time when suitable food organisms for survival of the young stages will not be present. (4) Change metabolic rates to the extent that individual organisms will be living under conditions of physiological stress, and thus be vulnerable to adverse conditions they may have otherwise resisted. (5) Cause an increase in the numbers of predators, parasites, and/or pathogens, and thus cause significant deterioration of a fisheries resource or create a public health hazard.

1162 - C3, E2

PERSISTENCE OF MANURE PHOSPHORUS AVAILABILITY IN CALCAREOUS SOIL,
Arizona Univ., Tuscon. Dept. of Soils, Water and Engineering.
J. L. Abbott, and T. C. Tucker.
Soil Science Society of America Proceedings, Vol 37, No 1, p 60-63, January-February, 1973. 1 fig, 5 tab, 11 ref.

Descriptors: *Fertility, *Waste disposal, *Phosphorus, Nitrogen, *Calcareous soils, Cotton, Barley, Alfalfa, Arizona, Cycling nutrients.
Identifiers: *Plant nutrition, Pollution control.

The contribution of P from manure to Calcareous soils was studied on a Mohave clay loam. Manure treatments involved different amounts and frequency of manure application, and were split with nitrogen variables of 0, 84, and 168 kg/ha. Total P content of manures ranged from 3-5 kg per metric ton during the course of study. The results indicated that manure is an effective source of P as illustrated by the increased P content of cotton, barley, and alfalfa tissue as well as soil analysis. Manuring at 2 or 3 year intervals at 22 metric tons/ha assures adequate P availability, while P availability from phosphate fertilizers may be negligible over the same period. (Marquard-East Central)

1163 - D2, D3, E3, F5

ACTIVATED SLUDGE AS A SOURCE OF PROTEIN,
Iowa State Univ., Ames. Dept. of Chemical Engineering.
A. S. Al-Zakri, and A. L. Frey.
Paper No. 72-581, presented at 1972 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 11-15, 1972, 18 p, 3 tab., 19 ref.

Descriptors: *Activated sludge, Bacteria, *Proteins, Amino acids, Nitrogen, Iowa, *Sewage treatment, Freezethaw tests, *Extraction, E. coli, Recycling, *Waste treatment.
Identifiers: Bacillus megaterium, Biuret reaction.

Activated sludge from a municipal sewage treatment plant was extremely high in protein content. A clear solution obtained from settled activated sludge was frozen and then dried in an oven to yield a solid containing by weight 16.25% nitrogen. A purified protein form was derived through a complicated extracting process. This protein compared favorably with whole cow's milk in animo acid contents. Extraction methods involved are expensive, but another technique, treatment for bacterial breakdown as required with recycling to animals, is promising. (Frantz-East Central)

1164 - A9, E3

SALMONELLA IN THE LAYING HEN. I. SALMONELLA RECOVERY FROM VISCERA, FECES AND EGGS FOLLOWING ORAL INOCULATION,
Louisiana State Univ., Baton Rouge. Dept. of Poultry Science.
N. A. Cox, B. H. Davis, A. B. Watts, and A. R. Colmer.
Poultry Science, Vol 52, No 2, p 661-666, March, 1973, 3 tab, 21 ref.

Descriptors: *Salmonella, *Farm wastes, *Poultry, Bacteria, Diseases, Analysis, Tissues, *Contamination, Eggs.
Identifiers: Inoculation, Seftenberg, Thompson, Typhimurium.

A study was made to determine the fate of Salmonella organisms after ingestion by the laying hen. Three species of Salmonella were used, i.e., senftenberg, thompson and typhimurium. Approximately one million cells of each species were introduced into the crop of 12 White Leghorn type laying hens for 10 days. The trials involving each species were carried out consecutively with thorough disinfection of equipment between trials. From each hen, feces and eggs were analyzed daily for Salmonella for the 10 day period. At the end of the 10 day trial a sample of blood was drawn from each hen for Salmonella analysis. In addition, the hens were slaughtered and a sample of the ovaries, kidneys, heart, liver and lungs was aseptically removed for analysis. Approximately 25% of the fecal samples contained the species of Salmonella under study. The percentage of positive recoveries from egg shells was less than 10% for all three species studied. Among the egg contents examined for all three species, only one egg yielded a positive recovery. All tissue samples were negative. It was concluded that there was no contamination of body tissues even after continuous ingestion of large doses of Salmonella organisms. Neither was there a problem of egg meat contamination among intact eggs. (East Central)

1165 - A7, A8

FLY CONTROL AND CHRONIC TOXICITY FROM FEEDING DURSBAN (0,0-DIETHYL 0-3, 5, 6-TRICHLORO-2-PYRIDYL PHOSPHOROTHIOATE) TO LAYING HENS,
Hawaii Univ., Honolulu. Coll. of Tropical Agriculture.
M. Sherman, and R. B. Herrick.
Poultry Science, Vol 52, No 2, p 741-747, March, 1973, 3 tab, 3 fig, 12 ref.

Descriptors: *Pesticide toxicity, *Farm wastes, *Poultry, Larvae, Feeds, Additives.
Identifiers: Dursban, *Fly control.

The effects of administering technical Dursban at concentration of 25, 50, and 200 ppm in the feed of laying hens were studied over a 52 week period. The estimated mean daily intake of Dursban was 2.48, 5.12, and 20.44 mg. per hen for those receiving 25, 50, and 200 ppm, respectively. Dursban at 50 ppm resulted in excellent control of larvae of Musca domestica L., Fannia pusio (Wiedemann), Chrysomya megacephala (F.), and Boettcherisca peregrina (Robineau-Desvoidy) but only moderate control of Parasarcophaga argyrostoma (Robineau-Desvoidy). No hen mortality occurred that could be attributed to the insecticidal treatment. There was a direct relationship between Dursban concentration and blood plasma cholinesterase inhibition. However, overall feed consumption, body weight, egg production, feed efficiency, egg weight, interior egg quality, and shell thickness were normal. Eggs from treated hens had no detectable off-flavors or off-odors. (East Central)

1166 - A1, E2, F2, F4

HOW MUCH MANURE PER ACRE.
E. D. Anderson.
The Farm Quarterly, Vol 27, No 5, p 44-45, Fall, 1972, 2 tab.

Descriptors: *Farm wastes, *Waste disposal, Hogs, Cattle, *Cycling nutrients, *Fertilizers, Groundwater pollution, *Legal aspects, Nitrates, Productivity, Potassium, Phosphorus, Regulation, Toxicity.

The laws of many states reflect concern over the harmful effects of manure on soil and water. Specific regulations for Kansas, Missouri, and Indiana are discussed. Concern is also reflected in university studies. One study was conducted at Michigan State University to determine a feasible rate of manure application. Manure applications at rates of 10, 20, and 30 tons per acre were made annually from 1963 to 1971 to Conover-Hodunk loam and Metea sandy loam. Soil samples were taken, corn yields were recorded, and mineral analyses of the corn were made. The optimum rate for applying manure to sandy loam was 10 tons per acre. Higher rates posed the hazard of nitrate contamination of ground water and buildup of available nitrogen and potassium. (Dudley-East Central)

1167 - A1, B1, F3

AGRICULTURAL WASTES--A MANAGEMENT PROBLEM,
Ohio State Univ., Columbus.
E. P. Taiganides.
In: Frontiers in Conservation, Proceedings, 24th Annual Meeting, Soil Conservation Society of America, Colorado State University, Fort Collins, August 10-13, 1969, p 90-92, (1969) 2 fig.

Descriptors: *Farm wastes, *Pollution, *Waste disposal, Subsidy, Chemicals, Confinement pens, *Municipal wastes, *Management.
Identifiers: Urban-rural interface.

Our nation's fundamental problems are poverty, pollution, population, and politics. It is necessary to have integrated and coordinated management of resources at the urban-rural interface to prevent environmental pollution. Although particular attention is given to waste management from animal confinement units, all production systems create waste. Regardless of the source-urban or rural- all of these wastes are either organic or inorganic and either solid or liquid. The wastes from all rural and urban areas must be considered as a regional problem whose solution will need the cooperation of the agricultural, industrial, urban, and other political sectors of the nation. A need exists to demonstrate the benefits of cooperation between the rural and urban sectors with an integrated regional scheme of using agricultural soils and nonproductive rural land for waste disposal. (Dudley-East Central)

1168 - A2, A4, A5, E2, F2

CALIFORNIA WASTE PONDS ARE PASSING THE TEST,
M. L. Elam.
Hoard's Dairyman, Vol 118, No 5, p 311, 362, March 10, 1973, 3 fig.

Descriptors: *Irrigation storage ponds, Leaching, Effluent, Nitrates, Salts, Leakage, Pump, Recycling, Dairy industry, *California, *Waste water (Irrigation), Fertilizers, *Farm wastes.

Three California researchers have supported waste ponds as safe and legal means by which dairymen may eliminate waste drainage problems. It is doubtful if the use of waste ponds harms other water supplies. They have little odor and insect production may be minimized. In a wide variety of soils tested, seepage and transfer of nitrogen and salts into soil were not problems. Farm wastes were easily applied to adjacent cropland. The researchers recommended the use of fifty gallons of water per cow each day and the partial emptying of waste ponds every four to six months. (Frantz-East Central)

1169 — A1, E2

CROP YIELDS FROM LAND RECEIVING LARGE MANURE APPLICATIONS,
Texas A & M University, College Station, Texas, and Texas Agricultural Experiment Station, El Paso, Texas, and Texas Agricultural Experiment Station, Pecos, Texas, respectively.
D. L. Reddell, P. J. Lyerly, and J. J. Hefner.
Presented at 1972 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 11-15, 1972, 14 p., Paper No. 72-960, 7 tab., 2 fig., 9 ref.

Descriptors: *Application methods, *Cultivation, *Crop yield, Nitrates, Forage, Salinity, *Farm wastes, Cattle, *Waste disposal, Texas, Ground water, Irrigation, Aquifer, *Fertilizers, Moisture content, Nutrients.

The objectives were to evaluate the pollution and crop growth due to deep plowing large amounts of beef manure. Two problems faced by feed lot operators have been finding sufficient land on which to use large quantities of feed lot waste and contending with the excessive salinity of such waste. Three locations with Hoban silty clay loam, and Vinton fine sandy loam were used and graduated amounts of waste up to 900 tons per acre were applied at depths of 14 to 36 inches. Rates of application and nitrate contents of crops yielded are recorded. Results of the study show peak yield and nitrate composition of crops to be on those acres with 25 and 50 tons of farm waste. However, in all locations researchers found that acres with 900 tons per acre yielded more than the check plot (0 tons per acre) and that those most heavily laden plots presented no major surface water pollution problem. (Frantz - East Central).

1170 - A4, B1, C3, E2

POLLUTION LOADS IN PERCOLATE WATER FROM SURFACE SPREAD SWINE WASTES,
Maryland Univ., College Park. Dept. of Agricultural Engineering.
H. L. Brodie. Water Resources Research Center, University of Maryland, College Park, Technical Report No. 13, October 1972. 25 p, 1 fig, 6 tab, 21 ref. OWRR A-019-MO (1).

Descriptors: *Groundwater pollution, *Farm wastes, *Hogs, *Percolation, *Flood irrigation, *Waste disposal, Nitrogen, Chemical oxygen demand, Phosphates, Chlorides, Sulfates, Maryland.

The effectiveness of the soil as a receptor for the concentrations of nutrients and organics in periodic high rate flood applications of liquid swine wastes was investigated. A lysimeter was used for collecting soil percolate waters after flood application of liquid waste or tap water and after rainfall in order to test the soil as a high-rate physical and biological filter for liquid swine wastes. Samples of the saturated flow were removed at depths of 25, 50, and 75 centimeters in the profile and tested for concentrations of chemical oxygen demand, ammonium nitrogen, chloride, total phosphate, and sulfate. The concentrations were compared with the concentrations of the applied liquid to determine net decrease of concentration through the soil profile. Results indicated that flood irrigation can lead to groundwater pollution. (Marquard-East Central)

1171 - E3

MONFORT LOOKS AT TREATED MANURE FOR TILE AND PLASTIC.
Calf News, Vol 10, No 8, p 4, August, 1972.

Descriptors: Feed lots, Plastics, *Tiles, Insulation, *Farm wastes, *Recycling, Waste disposal, *Waste treatment, *Ohio.
Identifiers: *Pyrolysis, Building materials.

Because future laws may restrict land application of feedlot manure, one feedlot has decided to use its wastes in a pyrolysis process to manufacture tile. While this will be the first commercial field test, laboratory results show that the product is superior to conventional tile. By using different proportions of manure and ground glass most building materials or insulation can be made. (Marquard-East Central)

1172 - D4, E3, F2

OXIDATION DITCH IS CATTLE FEED SOURCE.
Beef, Vol 8, No 2, p 24, October, 1971.

Descriptors: Oxidation lagoons, *Feeds, *Effluent, Cattle, Aerobic bacteria, Proteins, *Waste treatment, *Recycling, Iowa.

Effluent from an oxidation ditch was used as a feed source. A feed acceptance test found that animals on the effluent ration consumed significantly more feed. The United States Department of Agriculture and the Food and Drug Administration found the carcasses acceptable but warned that further tests must be run before commercial operators can use the effluent as a feed source. One limiting factor has been the protein level. regular feed rations contain under 20% protein while this effluent contains 46.8% protein. (Marquard-East Central)

1173 - A5, D1

NEW ODOR CONTROL PROJECT.
Calf News, Vol 10, No 7, p 22, July, 1972.

Descriptors: *Odor, Waste disposal, *Feed lots, *Lagoons, Oxygen, Nitrogen, Phosphorus, Potassium, Ash, Cattle, *Farm wastes, *Air pollution, *Waste treatment, *Oklahoma.

A new product to control odor and reduce manure volume from feedlots is now being produced by RAD Limited, Inc., of Yale, Oklahoma. The product works on dead organic matter only; and in treated lagoons, no odor gases are produced. On the feedlots, dry solids are decomposed to nitrogen, phosphorus, potassium, and ash. Further tests will determine the proper amounts to be used to prevent a cracking problem which is now encountered in the lagoons. (Marquard-East Central)

1174 - B2, D2, E2, F1

LIQUID WASTE SEEPS FROM ONE BASIN TO ANOTHER.
Feedlot Management, Vol 13, No 6, p 56-57, June, 1971.

Descriptors: Aquifer, Cattle, *Farm wastes, Feed lots, Fertilizers, Irrigation systems, *Settling basins, *Lagoons, *Waste treatment, *Waste disposal, *Water pollution control, Nebraska.

In the waste handling system manure solids and liquids go into a 'debris basin' where solids settle to the bottom. The liquid passes through a rock-filled retaining wall, seeps through a median strip to the 'blackwater basin,' and is pumped back up hill onto land. It is then channeled through irrigation outlets to surrounding croplands where it seeps into the ground, gives up its plant food nutrients, goes to an underground aquifer, and eventually deposits pollution-free water into the Missouri River. Total cost of the feedlot, including the $400 per acre cost of the pollution control system (built with farm labor and equipment most farmers have available) amounted to $27,000-$27 per animal. (Hisle-East Central)

1175 - F2

ANIMAL WASTE DISPOSAL,
Montana State Dept. of Health, Helena. Div. of Environmental Sanitation.
C. W. Brinck.
in: Montana Agriculture - Focus on Improving the Environment, (Proceedings), College of Great Falls, December 3-4, 1970, p 41-43. (1970).

Descriptors: *Water law, *Regulation, *Permits, *Feed lots, Waste disposal, Waste treatment, Water pollution control, Cattle, *Montana.

Montana water pollution laws are traced from 1907 through the 1970 regulation attempt to require feedlot location permits by 1973. Permits are to be issued on the basis of proximity of the feedlot to its neighbors, the possibility of odors being carried toward urban areas, fly problems, prevention of drainage to streams, the pollution of underground water and the potential for good feedlot maintenance. Permits will be required for all new construction. For existing feedlots, it is proposed that a permit be required for any feedlot located closer than one mile to the boundary of an incorporated city or town within one year after passage of the regulation. (Hisle-East Central)

1176 - E1

ANIMAL WASTE DISPOSAL,
Connecticut Agricultural Experiment Station New Haven Dept. of Soil and Water.
C. R. Frink.
Compost Science, p 14-15, November-December. 7 ref.

Descriptors: *Farm wastes, *Waste disposal, Water pollution, Nitrates, Nutrients, Sewage treatment, *Fertilizers, *Farm practices.

Recent data show that manure applied to field crops does not improve yields enough to offset the cost of hauling and spreading. Alternatives are (1) stop producing manure, (2) hide it on the 'back forty,' or (3) place it in a sewage treatment plant. These are not acceptable because we need the food produced by the animals, 'hiding it' may contaminate drinking water, and sewage treatment is too expensive. With alternative methods exhausted, the data must be re-examined for application of manure to field crops. Studies indicate that improved agronomic practices will increase the efficiency of nitrogen utilization and reduce the total nitrogen imparted on the farm. It is also suggested that, when feasible, animal wastes be applied to forest lands. (Marquard-East Central)

1177 - A2, E2

DISPOSAL OF BEEF FEEDLOT WASTES ONTO CROPLAND,
Kansas State Univ., Manhattan. Dept. of Agricultural Engineering.
H. L. Manges, L. S. Murphy, and E. H. Goering.
Paper No. 72-961, presented at 1972 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 11-15, 1972, 12 p, 5 fig, 1 tab, 6 ref.

Descriptors: *Farm wastes, *Waste disposal, Cattle, *Feed lots, Runoff, *Rates of application, *Irrigation, Corn (Field), Soil properties, Nitrogen, Phosphorus, Potassium, Sodium, Salinity.
Identifiers: Greensberg silty clay loam, Plant population, Forage yields.

A series of field plots were established to determine the influence of waste loading rates on corn forage yield and on soil properties. Separate field plots of Greensberg silty clay loam soil were established for disposal of runoff and manure. Runoff was applied to the land during the irrigation season; manure was spread after corn harvest and plowed under to a depth of 12 inches. Corn was surface planted on these plots with no pre-irrigation. Herbicides were used to control weeds, and irrigation water (from a well) supplemented runoff treatments and provided adequate moisture for the manure plots. The plants were counted to evaluate effects of treatments on population; the forage was weighed when ready for ensiling; and soil samples were taken at a depth of 10 feet, with additional samples at 3 feet in the manure plots, prior to corn planting, to assess decomposition of the manure. Conclusions were that corn plant population decreases linerily with increasing accumulated feedlot waste loadings; annual application of 10 inches of feedlot runoff gave maximum corn forage yields; and land disposal of feedlot wastes can lead to saline soil conditions and high nitrate-nitrogen concentrations in the soil profile. (Hisle-East Central)

1178 - A5, B1, C5

ODOR CONTROL MAY BE A BIG CONCERN,
Wisconsin Univ., Madison.
J. C. Converse.
Hoard's Dairyman, Vol 118, No 13, p 819, July 10, 1973.
U.S. Patent No 3,744,637, 5 p, 2 fig, 7 ref; Official Gazette of the United States Patent Office, Vol 912, No 2, p 550, July 10, 1973.

Descriptors: *Patents, Equipment, *Aeration, Separation techniques, *Waste water treatment, Water pollution control, Pollution abatement, Water quality control, *Baffles.
Identifiers: Clarification.

A waste treatment tank has a baffle dividing it into an aeration and a clarification section. Air flow is introduced into the tank at the bottom of the baffle in the aeration section and at the top of the baffle in the clarification section. Aeration section air flow creates a circulatory mixture flow upward along the lower wall surface of the baffle. Air introduced into the clarification section skims sewage solids from that section and forces solids into the aeration tank section. (Sinha-OEIS)

1179 - A2, B2, D2, E2, F1

THE PRICE TAG TO STOP FEEDLOT RUN-OFF,

Beef, Vol 8, No 8, p 6-7, April, 1972, 4 tab.

Descriptors: *Farm wastes, *Waste disposal, *Feed lots, Settling basins, Lagoons, Irrigation, Nutrients, Runoff, Diversion structures, Terraces (Agricultural), Missouri, *Installation costs, *Operating costs, Cattle.

A Missouri engineer calculates the cost of a system to prevent feedlot run-off at $1,000 to $3,500 plus $300 to $600 yearly operation costs. His system consists of a diversion terrace to catch run-off, a settling basin to eliminate most solid waste in run-off, and a lagoon to hold run-off water. Irrigation equipment to pump run-off to adjacent farmland is included in the cost. Pumping rates vary and liquid may be distributed by gated pipe, hand carried sprinklers, or traveling Big Gun systems. The lagoon, ranging from 110,000 cubic feet upward, requires an earthen dam. Costs on all aspects of the system have been itemized in tables according to capacity lot sized from 200 to 1,200 head. (Frantz-East Central)

1180 - A2, B1, C5, D1, F1

CATTLE FEEDLOT POLLUTION STUDY,
Texas Tech Univ., Lubbock. Water Resources Center.
D. M. Wells, E. A. Coleman, W. Grub, R. C. Albin, and G. F. Meenaghan.
Interim Report No. 1 to Texas Water Quality Board, November, 1969. 34 p, 6 fig, 11 tab.

Descriptors: *Cattle, *Feed lots, *Farm wastes *Waste disposal, *Waste treatment, Runoff, Precipitation, Water pollution, Irrigation, Percolation, Waste storage, Ponds, Management, Biochemical oxygen demand, Nitrogen, Aerobic treatment, Anaerobic digestion, Field crops, Germination, Texas, Cattle.
Identifiers: Flushing.

Alternative feedlot management and waste disposal systems were evaluated and agronomic studies were conducted for the economic utilization or treatment of feedlot wastes. Both dirt and concrete-surfaced feedlots were used in a conventional manner. It was tentatively concluded that conventional aerobic treatment processes are not economically feasible solutions to the problem of treatment and disposal of cattle feedlot runoff resulting from natural precipitation; that runoff from feedlots operated in a conventional manner is not suitable for direct application as irrigation on most field crops; that anaerobic treatment processes offer the best hope for treatment of feedlot runoff; and that storage of feedlot runoff in unlined ponds and treatment and disposal of feedlot runoff on agricultural lands may pose a hazard to groundwater pollution. Recommendations were that further study be given to the possibility of changing feedlot practices to provide for daily flushing and treatment by conventional means; that the agronomic studies be continued to determine safe rates of application and safe dilution factors for selected crops; and that the infiltration studies be continued and expanded to include the analyses of cores taken in the vicinity of storage ponds and the construction and operation

1181 - A2, C5, D4, E3

SALMON THAT NEED NEVER SEE THE SEA,
Rhode Island Univ., Kingston.
T. L. Meade.
The American Fish Farmer, Vol 4, No 5, p 9-10, April, 1973, 3 fig.

Descriptors: *Recirculated water, *Salmon, Rhode Island.
Identifiers: *Controlled environment, *Toxic wastes, Denitrification column.

A system capable of raising salmon in a controlled environment was developed. Salmon were cultured in this controlled environment from incubation of eggs through the grow-out phase. This facility is outdoors and consists of four insulated silo-like tanks, 5 feet in diameter and 12 feet high. These tanks provide two separate culture units, each consisting of two tanks and associated biological filters, pumps, refrigeration, heating, and oxygen units. The system is essentially closed with continuous reuse of the water until the buildup of nitrate nears an unacceptable level. The results of these studies have seen incorporated in the design of a denitrification column which, when placed in operation, should eliminate the need to discharge water from the system. (Hisle-East Central)

1182 - C4, C5, D2, E3

BACTERIOLOGICAL PROCEDURES FOR ANALYZING WET AND DRIED POULTRY FECES,
Michigan State Univ., East Lansing. Dept. of Poultry Science.
H. C. Zindel, T. S. Chang, and G. R. Carter.
Journal Article No. 5928, Michigan Agricultural Experiment Station, College of Agriculture and Natural Resources, Michigan State University, East Lansing, 1972, 4 p, 2 ref.

Descriptors: *Farm wastes, *Dehydration, *Poultry, *Bacteria, *Chemical analysis, Recycling, Incubation, Michigan.

The accurate analysis of feces, both wet and dry, for chemical and bacteriological content is important since animal feces is a raw product which has great potential if properly gathered, processed and utilized. When Michigan State University began a dehydration process several years ago, it obtained bacteria count and identification as well as chemical analysis for both wet and dry fecal samples. The bacteria present in the feces after the drying process were identified and recorded. Some bacteria were present after the drying process, but they were not thought to be significant because most of them were normal flora in the intestinal tract of chickens and some of them are commonly known contaminants. Their presence either suggested that the retention time of the feces in the dryer was not long enough to destroy all bacterial populations or that they were recontaminated while leaving the drying unit. (Hisle-East Central)

1183 - B1, C5, E2, F1

CONFINEMENT. IN ARIZONA.

Calf News, Vol 11, No 3, p 52-53, 68-69, March, 1973.

Descriptors: *Farm management, *Farm wastes, *Confinement pens, *Feed lots, *Cattle, Effluent, Waste disposal, Irrigation system, Fertilizers, Alfalfa, Arizona.

Arlington Cattle Company decided to expand their Arizona feedlot operations through confinement housing in order to make manure management easier. The following advantages were listed for confinement housing: (1) more economical, (2) easier to handle animals, (3) better working conditions, (4) better management of mud, dust, odor, and flies, (5) a savings in manure handling of about $13,000 yearly. The manure system for the new facility will be scrapers running lenghwise under the slotted floor barns. Gravity will take the effluent to a pumping station which will move it to cropland where it merges with the flood irrigation system. Alfalfa will be grown on this property owned or controlled by Arlington Cattle Company. (Dudley-East Central)

1184 - B1, D4, E3

ANIMAL WASTE MANAGEMENT IN HAWAII,

Hawaii Univ., Honolulu. Dept. of Civil Engineering.
G. L. Dugan, R. H. F. Young, and G. Takamiya.
Journal Water Pollution Control Federation, Vol 45, No 4, p 742-750, April, 1973, 1 fig., 4 tab., 22 ref.

Descriptors: *Farm wastes, *Livestock, *Waste disposal, *Waste treatment, Air pollution, Water pollution, Goundwater pollution, Waste water treatment, Biochemical oxygen demand, Nitrogen, Ponds, Drying, Incineration, Recycling, *Hawaii.
Identifiers: Subtropical environment, Land spreading, Composting.

The unavailability of land suitable for accepting animal excrement near large animal raising facilities is a very critical problem in Hawaii. The problem is intensified by the pollution potential caused by the close proximity of land to the ocean. Various methods of managing animal waste ranging from land spreading to drying and incineration are discussed. A waste handling system that seems to be adaptable to a subtropical environment is a hydraulic recycling system incorporating photsynthetic reclamation. The process is based on hydraulic handling of animal excrement; gravity liquid-solids separation; aerobic biological treatment in which oxygenation can be accomplished either by the photosynthetic activity of algae or by mechanical aeration; anaerobic biological treatment; and harvesting algae from the aerobic phase, which provides the potential for nutrient recovery in the form of a high-protein animal feed supplement. (Dudley-East Central)

1185 - A1, B1, F1

ECONOMICS OF WATER POLLUTION CONTROL,

Economic Research Service, Washington, D.C.
J. P. Biniek.
In: Frontiers in Conservation, Proceedings, 24th Annual Meeting, Soil Conservation Society of America, Colorado State University, Fort Collins, August 10-13, 1969, p 102-106 (1969) 1 tab., 10 ref.

Descriptors: *Pollution, *Water pollution, *Economics, Herbicides, *Water pollution control, Animal wastes, Waste disposal, Livestock, Feed lots, Runoff, Waste treatment, Percolation, *Management.

In broad, general terms many problems in the economic area of pollution control are discussed. Pollution is defined as 'the unfavorable alteration of our surroundings, wholly or largely as a by-product of man's action.' Many means of ridding ourselves of pollutants often result in further pollution. The difficulty of securing a balance between production needs and the externalities of economics (the beneficial) and diseconomies (the harmful) is discussed along with the costs of pollution control, the economics of agricultural pollution and the role of economics as a whole. (Dudley-East Central)

1186 - D1, E1, F2

TECHNICAL AND LEGAL CONTROLS FOR THE DISPOSAL OF ANIMAL WASTES,

Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
Raymond C. Loehr.
Proceedings of the Industrial Waste Conference, 23rd, 1968, p 507-519. 2 fig, 5 tab, 21 ref.

Descriptors: *Animal wastes, *Runoff, *Management, *Farm management, *Aerobic treatment, *Water pollution, *Water pollution control, *Water pollution treatment, *Solid wastes, *Legal aspects, Runoff forecasting, Cattle, Hogs, Poultry, Farm wastes.
Identifiers: *Manure, *Agricultural runoff, Anaerobic lagoons.

Several alternatives exist for disposal of animal wastes: (1) land disposal of liquids and solids, (2) solids combustion with land disposal of liquid, and (3) discharge of solids and liquids to receiving waters. All these alternatives are potential sources of water pollution. The quality of treated and untreated animal waste waters, both from a legal point of view and a farmers point of view, are discussed. Animal wastes are normally semi-solid, thus high in BOD, COD, suspended solids, Na, NH3. If rainfall runoff is allowed to mix with the animal wastes, a larger volume of waste will need to be treated. Many states now consider large livestock operations to be industrial processes and require treatment of wastes in such a manner that receiving waters are not harmed by discharge of animal waste waters. Waste water runoff holding ponds are commonly used with intermittent discharge to receiving waters or land disposal. Several processes are used for treatment of animal wastes, the more common being anaerobic lagoons, aerobic lagoons, aerated lagoons, oxidation ditches, or a combination of anaerobic-aerobic treatment. In more arid areas, runoff holding ponds are sometimes satisfactory. Handling and treating animal wastes as a liquid usually involves less labor, less expense, and thus is more commonly found in large livestock operations where concrete pens are found and confinement is practiced. Since liquid wastes require more treatment, handling the animal wastes directly as a semi-solid with land disposal might be a more economic method. (Makela-Texas)

1187 - B1, D4, E3

THE MANAGEMENT AND DISPOSAL OF DAIRY MANURE,

Washington State Univ., Pullman. Coll. of Engineering.
Donald E. Proctor.
Proceedings of the Industrial Waste Conference, 23rd, 1968. p 554-566, 8 fig.

Descriptors: *Animal wastes, Management, *Farm management, *Dairy industry, *Algae, *Cattle, Slurries, Spraying, Activated sludge, Farm wastes.
Identifiers: *Manure, Anaerobic lagoon, Aerated lagoon.

Dairy manure can be either an asset or a liability depending on the farmer's management policies. Increased demand for livestock-derived products, specialization of farm operations, confinement rearing, cheaper chemical fertilizers, urban sprawl and farm area encroachment, and higher aesthetic standards are all facets of the changing problem of manure disposal. Of these changes, confinement rearing is most significant. Not only is the manure concentrated into a smaller area, but rainfall runoff can treble the waste volume to be handled. Two Washington State dairy farms received Federal Demonstration Project Grants, the Knott Dairy Farm of the Washington State University receiving a grant from the FWPCA, and the Monroe Honor Farm of the State of Washington Institutional Farm Industries receiving a grant from the Public Health Service. The two-year project at the Knott Dairy Farm proposed to (1) demonstrate the capabilities of an anaerobic lagoon for first stage treatment of dairy manure, (2) demonstrate the comparative capabilities and economics of activated sludge and naturally aerated lagoons for second stage treatment and (3) determine whether it is possible and practical to reduce the nitrogen and phosphorus content of the treated effluent by algae propagation and harvesting for use as cattle feed. The Monroe Honor Farm project proposed to (1) demonstrate the capabilities of an anaerobic lagoon for first stage treatment of dairy manure. (Makela-Texas)

1188 - A5, B1, C3

IDENTIFICATION OF BEEF CATTLE FEEDLOT ODORS,

Texas Tech Univ., Lubbock. Dept. of Chemical Engineering.
R. M. Bethea, and R. S. Narayan.
Transactions of the ASAE, American Society of Agricultural Engineers, p 1135-1137, 1972, 2 fig., 2 tab., 10 ref. (Order No. T 1135).

Descriptors: *Air pollution, *Odor, *Cattle, *Feed lots, *Farm wastes, *Gases, Gas chromatography, Solubility, Alcohols.
Identifiers: Amines, Aldehydes, Esters, Carbonyls.

The qualitative nature of the gases present in the atmosphere around a beef cattle feedlot was studied. The selective solubility method was adopted for identification of volatile organic compounds caused by cow manure. Gas chromatographic analysis extended the findings of the solubility tests. A feedlot chamber was set up for a 550 pound steer in order to obtain information about compounds present in the atmosphere of enclosed feedlots. The chamber was managed three ways. One week it was thoroughly cleaned and washed each day. The next week it was shoveled out, but not washed. The third week it was not cleaned at all. During the first phase, only a few odoriferous contaminants were generated. When daily washings were discontinued, indole and skatole were detected in the chamber atmosphere. The number of compounds present in this atmosphere increased threefold during the last phase. It is inferred that chamber management has tremendous influence on the organic compounds present in the atmosphere of an enclosed feedlot. (Hisle-East Central)

1189 - B3, C3, E2, F1

A FEEDER LOOKS AT ANIMAL WASTE DISPOSAL,
Miller Feed Lot, Shepherd, Mont.
A. L. Miller.
In: Montana Agriculture - Focus on Improving the Environment, (Proceedings), College of Great Falls, December 3-4, 1970, p 44-46. (1970).

Descriptors: *Farm wastes, *Waste disposal, *Feed lots, *Fertilizers, Cattle, Nitrogen, Phosphorus, Silage, Missouri, Montana.

January 1, 1970, figures are given for the number and size of the nation's feedlots. The possibility of using animal wastes as a fertilizer is emphasized. The Miller Feed Lot analyzed its animal waste to see if it would be profitable as a fertilizer. Its value from the nitrogen phosphorus alone was about $1.00 to $3.00 per ton, so the company decided to sell the fertilizer to the farmers at not over 50 cents per ton. In order to do this quickly, a five yard capacity front-end wheel loader was used to stack the fetilizer in expanded pens and to load it on the farmers' trucks. (Hisle-East Central)

1190 - C3

NUTRITIONAL INTERRELATIONSHIPS OF DIETARY CALCIUM, PHOSPHORUS, AND MAGNESIUM IN SHEEP,
Florida Univ., Gainesville. Dept. of Animal Science.
C. F. Chicco, C. B. Ammerman, J. P. Feaster, and B. G. Dunavant.
Journal of Animal Science, Vol 36, No 5, p 986-993, May 1973, 1 fig, 6 tab, 28 ref.

Descriptors: *Calcium, *Phorphorus, *Magnesium, *Sheep, Metabolism.
Identifiers: *Nutritional interrelationships, Plasma, Fecal excretion, Basal diet, Femur deposition

Four experiments were conducted with 116 wethers to study dietary interrelationships of calcium, phosphorus and magnesium. Including all experiments dietary levels varied as follows: calcium 0.13 to 0.78%, phosphorus 0.12 to 0.36%, and magnesium 500 to 7,750 ppm. Treatment effects on fecal, urinary, plasma and bone mineral levels were observed. In two experiments, the utilization of oral Ca and P was measured. High dietary calcium increased calcium in plasma ($P<.05$) and feces ($P<.10$ to $P<.01$) and decreased magnesium in bone and plasma ($P<.05$). High calcium increased fecal phosphorus ($P<.01$) and tended to reduce plasma phosphorus. Excess dietary magnesium reduced plasma calcium ($P<.01$), appeared to increased fecal loss of calcium but had no effect on bone calcium. High magnesium increased the level of magnesium in urine ($P<.01$), plasma ($P<.05$ to $P<.01$) and bone ($P<.05$ to $P<.01$). High dietary phosphorus with a Ca:P ratio of 1:3 increased fecal calcium ($P<.05$), but, at a higher level of calcium with a Ca:P ratio of 1:1, phosphorus enhanced calcium retention. Supplemental phosphorus increased plasma phosphorus and reduced plasma calcium ($P<.01$). (East Central)

1191 - A5, A8, B1, D4, E2

MOVE TO NEW LOCATION SOLVES MANY PROBLEMS FOR CUSTOM FEEDER,
E. W. Manthey.
Feedlot Management, Vol 13, No 8, p 34-44, August, 1971.

Descriptors: *Relocation, *Farm wastes, *Feed lots, Arizona, Cattle.
Identifiers: Retention pond, Fly parasites, Biological fly control, Preconditioning, Feeding out and finishing.

Ecology and odor complaints from residents living near the Phoneix stockyards plus the problem of disposing economically of cattle wastes in an urban area were only two of the reasons why the Producers Livestock Marketing Association built a new feedlot of Maricopa. Another factor was plentiful nearby farmland which could absorb cattle-produced wastes in the new location at a fair return. The new feedlot was graded to include an anti-pollution pond for bacterial and anaerobic breakdown of animal wastes and for retention of the effluent on the land. A detailed description of the construction of the feedlot is given. Both the feeding out and finishing cattle process, and the preconditioning of stockers and feeders are discussed. Gnats (2 or 3 kinds that come from Africa) are used for biological fly control. (Dudley-East Central)

1192 - A2, B1, F2, F4

IMPLICATIONS OF WATER QUALITY LAWS FOR THE FEEDLOT INDUSTRY,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Economics.
Ron E. Shaffer, and Daniel E. Badger.
Oklahoma Current Farm Economics, March 1970, Vol 43, No 1, p 3-11. 2 tab, 19 ref.

Descriptors: *Water pollution control, *Pollution abatement, *Water management (Applied), *Water Quality Act, *Environmental effects, Lagoons, Water pollution effects, Waste disposal, Cost sharing, Legal aspects, Social aspects, Fertilizers, Benefits, Arid lands, Dry seasons, Waste dilutions, Stabilization, Dissolved solids, Oklahoma, Texas, Return (Monetary), Profit, Water utilization, Productivity, Streams, Legislation, Cattle, Water treatment, Waste treatment.
Identifiers: *Quality alteration, *Trade off, *Feed lot industry, *Beef feeding industry, *Feed Yards Act.

Agricultural water users historically considered the amount of wastes and impurities that could be discharged; recent emphasis is to keep pollutants from streams. Feedlot operators must integrate and coordinate the total production process to efficiently use resources for a profitable return. They must know what legal and social requirements they have in environmental protection through water management. Large-scale operations in Texas and Oklahoma, with up to 40,000 head capacity, predominate the beeffeeding industry. The Water Quality Act and Feed Yards Act require elimination of interstate water pollution and water-resource enchancement. Oklahoma requires feedlot licensees to provide reasonable waste disposal and drainage to avoid pollution. Feedlot runoff is discussed in terms of removing undesirable solids by stabilization lagoons and dilution. These methods present special problems in dry seasons and in arid lands. Waste disposal of manure as fertilize sales is not economical, but social and legal benefits of pollution-free rivers are high. Cost sharing waste control projects are outlined. Future feedlot locations must consider access to waste disposal as well as beef markets. Environmental quality is a dimension new to the industry, which will be developed when society can tradeoff between production efficiency and environment, or develop cost-sharing programs. (Popkin-Arizona)

1193 - A2, C2, C3, C4

CHARACTERISTICS OF MILKING CENTER WASTE EFFLUENT FROM NEW YORK STATE DAIRY FARMS,
Cornell Univ., Ithaca, N. Y. Dept. of Food Science.
R. R. Zall.
Journal of Milk Food Technology, Vol. 35, No. 1, p 53-55, 1972. 1 fig, 6 tab, 3 ref.

Descriptors: *Sewage effluents, *Waste identification, *Dairy industry, *Cattle, Effluents, Farm wastes, Biochemical oxygen demand, Water pollution sources, Nutrients, Nitrates, Nitrites.

Waste profile studies of milking center (milkhouse and milking parlor) wastes from twenty-four New York State dairy farms in 20 different countries were conducted to determine the characteristics and amounts of wastes. Composite samples were collected in small plastic swimming pools, and two-quart portions transported to the laboratory where biological and chemical analyses were performed. Waste volumes were physically measured at the farms. Sixty percent of the experimental sites sampled showed a sewage load of less than 10 lb. of BOD per day farm with approximately 4 gal of waste per cow per day from milking center operations. The amounts of nitrates and nitrites were no greater than the levels from sewage treatment plant effluents. Also, there were relatively small differences in soluble N and P compounds when compared with animals/farm or with pounds of BOD produced in milking centers. The principal solids in the wastes were manure, food, bedding, and hood dirt. (Snyder-Battelle)

1194 - A2, F3, F4

REVIEW OF NATIONAL RESEARCH POLICY ON EUTROPHICATION PROBLEMS,
Water Pollution Research Lab., Stevenage (England).
A. L. Downing.
Journal of the Society for Water Treatment and Examination, Vol 19, Part 3, p 223-238, 1970. Discussion.

Descriptors: *Eutrophication, *Algal control, Financing, Plant growth, Toxicity, Nutrients, Water quality, Nitrates, Planning, Nitrogen, Phosphorus, Reservoirs, Fisheries, Water supply, Costs, Water demand, Economic justification, Aquatic weed control, Rivers, Agriculture, Rooted aquatic plants, Drainage, Runoff, Fertilizers, Livestock, Economics, Fish kills, Inhibitors, Water pollution sources, Human diseases.
Identifiers: *Research policy, *United Kingdom, *Future trends, Cladophora, Research strategy, Thames River (England), Lee River (England).

For new water supplies and for greater recreational exploitation of natural waters in the United Kingdom, appropriate levels of activity and lines of inquiry are needed. Cost incurred as a result of eutrophication will probably not increase to more than about double the present expenditures by this century's end. If algal and weed growth were fully understood, perhaps some comparatively simple preventive measures could be applied for eliminating these nuisances. A balanced program is required for basic research and for empirical investigations, especially on static waters. Since factors influencing algal growth vary geographically, examining the influences of location of water may show that one method of control may be more appropriate than another. Though it is unlikely elimination of phosphates from detergents would materially reduce algal problems, search for trouble-free substitutes should continue. Processes used in removing nitrogen and phosphorus from effluents should be examined for suitability of removing other substances (carbon adsorption, ozoniation), and ability of effluents to support algal growth by unsuspected components is profoundly important. Growth of weeds in rivers and effect of sewage effluent on Cladophora needs investigation. Insuring that present efforts are well coordinated takes precedence over embarking on many new initiatives. (Jones-Wisconsin)

1195 - A2, A3

AGRICULTURAL POLLUTION OF WATER BODIES,
Agricultural Research Service, Washington, D.C.
William M. Edwards, and Lloyd L. Harrold.
The Ohio Journal of Science Vol 70, No 1, p 50-56, Jan 1970.

Descriptors: *Water pollution, *Farms, *Livestock, *Phosphorus, *Nitrates, *Pesticides,

*Soil conservation, Runoff, Erosion, Percolation, Sediment, Waste.
Identifiers: Lake Erie, Barnyard, Solids, Liquids.

Pollution of Ohio's water bodies is of growing public concern; industrial, urban, and rural sources are becoming the subject of critical examination. Rural sources are soil sediment, plant nutrients, animal waste, and pesticides. Pesticides and phosphorus are absorbed rapidly and strongly to soil particles. Therefore reductions in sediment, phosphorus, and pesticide pollution are achieved by soil-erosion-control farming practices. More acres need to be brought under erosion-control practices. Nitrates dissolve in water and are carried by surface flow to streams and lakes, and by percolating water to underground aquifers. Increases in the use of nitrogen fertilizer, in evidence almost everywhere, could result in serious contamination of water bodies, if soil enrichment greatly exceeds the crop demand. Areas where large-scale livestock and poultry production is concentrated are also potential sources of serious pollution. In Ohio, animal-waste pollution problems are being studied at The Ohio State University, and movement of pollutants in surface and subsurface waters on drainage plots near Castalia are being studied by the Ohio Agricultural Research and Development Center and on agricultural watersheds by USDA Agricultural Research Service at Coshocton, Ohio. (Harrold-USDA, ARS)

1196 - A2, B1, F2

CATTLE FEEDERS MUST COMPLY WITH ANTI-POLLUTION LAWS,
R. Reiman.
The Cattleman, Vol. 58, No. 2, p. 43, 58, July 1971.

Descriptors: *Legal aspects, *Pollution abatement, *Agricultural runoff, *Return flow, *Waste disposal, Cattle, Permits, Discharge (Water), Animal wastes (Wildlife), Feedlots, Texas, New Mexico, Oklahoma, Irrigation water, Pollutants, Surface waters, Water pollution control, Sediment discharge, Erosion, Salinity, Fertilizers, Pesticides, Water quality control, Taxes.

Current federal anti-pollution laws for cattle feeders are reviewed. The Environmental Protection Agency (EPA) now requires that a permit be obtained from the Army Corps of Engineers before any discharges or deposits can be made into a navigable stream. The ruling applies to feedlots with more than 1,000 animal units and all new feedlots. It applies to at least 306 lots in Texas, 45 in New Mexico and 48 in Oklahoma. It is estimated that 10,000 beef cattle on a feedlot produce 200 tons of daily waste, comparable to a 100,000 to 200,000-person city. Agricultural runoff, irrigation return flow and confined feeding operations concern the EPA. The greatest quantity of pollutants in the surface waters of the country is sediment caused by erosion. Increased salinity concentration in receiving waters is a problem, especially when coupled with fertilizers and pesticides. Management of polluted waters is a growing research area. Some practices qualify for tax breaks. (Popkin-Arizona)

1197 - A2, A4, A9, C3

NUTRIENT LOSSES FROM AGRICULTURAL LAND,
Imperial Chemical Industries Ltd., Jealott's Hill (England). Jealott's Hill Research Station.
T. E. Tomlinson.
Outlook on Agriculture, Vol 6, No 6, p 272-278, 1971. 2 fig, 8 tab 19 ref.

Descriptors: *Eutrophication, *Agricultural runoff, Fertilizers, Nitrates, Percolation, Farm wastes, Drainage water, Feed lots, Nitrogen, Phosphorus, Potassium, Rivers, Leaching, Soil erosion.
Identifiers: Britain.

Considering problems of eutrophication and high nitrate levels specifically toxic to infants, a review was made of known nutrient losses from agricultural land and how these relate to farming, especially in England. Nutrients are lost from farmland by drainage water percolating through the soil leaching soluble plant nutrients, by inefficient return of livestock excreta to the land, and by erosion of surface soils or movement of fine soil particles into subsoil drainage systems. Lysimeter studies indicate that the nature of the cropping greatly influences loss of nitrate in drainage and confirm the possibility of large losses from soil reserves in certain circumstances. Many soils contain large reserves of nitrogen which can be released as nitrate over long periods of time, even if the soils are not cropped or fertilized. Phosphate levels of drainage water from soils are low, as illustrated by lysimeter studies. There is little danger that a large proportion of potassium fertilizer application will be lost in drainage. It is concluded that, at the present time, there do not seem to be grounds for serious concern about a general nitrate level rise in English rivers. (Jones-Wisconsin)

1198 - A3, C2, C3

CHEMICAL AND DETRITAL FEATURES OF PALOUSE RIVER, IDAHO, RUNOFF FLOWAGE,
Eastern New Mexico Univ., Portales. Dept. of Biological Sciences.
Philip A. Buscemi.
Oikos, Vol 20, No 1, p 119-127, 1969. 3 fig, 3 tab, 30 ref.

Descriptors: *Runoff, *Groundwater, *Seston, *Sediments, Organic matter, Currents (Water), Water pollution sources, Surface runoff, Rainfall, Snowmelt, Surface waters, Streams, Hydrogen ion concentration, Iron, Magnesium, Nitrates, Phosphates, Algae, Detritus, Pulp wastes, Livestock, Idaho.
Identifiers: Tree bark, Charcoal, Algal growth, Stream concourse, Palouse River (Idaho).

Water and sediment samples were collected at four stations established on Palouse River, Idaho. Determinations included pH, nitrate, phosphate, iron, manganese, hardness, suspended detritus (drifting seston), and organic content of sedimentary deposits. The results show influence of rainfall, melt water, stream inflow, and mill pond on seston concentration. Variation in chemical composition of water indicated the effect of either melt water runoff or subterranean discharge. The increased pollution of water and sediment enrichment in organic matter were correlated with locations of lumber camps and cattle grazing. (Wilde-Wisconsin)

1199 - A7, C3, C4

IMPROVED PROCEDURES FOR THE DETERMINATION OF OXYTETRACYCLINE IN MILK, MILK PRODUCTS; CHICKEN MUSCLE, LIVER; AND EGGS,
Rutgers - The State Univ., New Brunswick, N.J. Dept. of Biochemistry and Microbiology.
S. E. Katz, and C. A. Fassbender.
Bulletin of Environmental Contamination and Toxicology, Vol 7, No 4, p 229-236, April 1972. 8 tab, 6 ref.

Descriptors: *Antibiotics (Pesticides), *Analytical techniques, *Evaluation, *Pollutant identification, *Milk, *Poultry, Organic pesticides, Methodology, Centrifugation, Bioassay, Pesticide residues, Methodology, Foods.
Identifiers: *Biological samples, *Oxytetracycline, Milk products, Tissues, Muscle, Liver, Eggs, Detection limits, Bioaccumulation, Recovery, Chlortetracyline.

The improved procedures for determining oxytetracycline in milk and dairy products, chicken muscle tissue and livers, and eggs are evaluated. The procedures used were based upon those developed for chlortetracycline in similar materials and are compared to the procedures listed in the FDA compendium of methods and protocols. The procedural improvements include pH adjustment, centrifugation, single agar layer, high temperature seeding and spreading of agar, and the use of a surfactant. A summary of the detection limits and analytical measurement for the individual procedures shows that the centrifuge modification, pH adjustment where applicable, and the use of surfactant when necessary have significantly improved the ability to measure residues of oxytetracycline in milk, eggs, and chicken tissue. (Holoman-Battelle)

1200 - A3, C1

PROGRESSIVE CHANGES IN THE CLADOCERAN AND MIDGE FAUNA DURING THE ONTOGENY OF ESTHWAITE WATER,
Indiana Univ., Bloomington.
Clyde E. Goulden.
Verhandlungen der Internationalen Vereinigung fur Theoretische und Angewandte Limnologie, Vol 15, p 1000-1005, 1964. 2 fig, 13 ref.

Descriptors: *Midges, *Lakes, Eutrophication, Pollen, Sediments, Climates, Productivity, Sheep, Hypolimnion, Anaerobic conditions, Daphnia.
Identifiers: *Esthwaite Water (England), *Cladocera, *Ontogeny, Chydoridae, Daphniidae, Bosminidae, Sididae, Polyphemidae, Leptodoridae, Deforestation, Chironomus, Sergentia, Tanytarsus, Ceriodaphnia.

Changes in total populations throughout Esthwaite Water's history and successional changes of Cladocera and midges associated with eutrophication are discussed. The Cladocera species were divided into the 'chydorids' and the 'non-chydorids,' mostly planktonic in habit. The Cladocera and midges suggest that Esthwaite Water was an oligotrophic lake during most of its development and only within the last 900 years became eutrophic under man's influence. Further, they indicate there were four periods of increased productivity during the lake's development associated with climatic or cultural changes in the drainage basin. Greater productivity is expected in these intervals, and the fact that the Cladocera correctly suggest this implies that they can be of great usefulness for determining past productivity in lakes. Cladoceran remains in lake sediments appear to be a valuable tool for paleolimnologists. They may be used to determine periods of climatic and cultural changes and for deducing past limnological conditions of a particular body of water. By studying the distribution and abundance of individual species in the sediment, we can estimate the ecological requirements of these species. This in turn will suggest fruitful areas of further research on living forms. (Jones-Wisconsin)

1201 - A2, A3, A4, F2

OKLAHOMA FEED YARDS ACT.
Oklahoma Statutes Ann Title 2, secs 9-208, 9-210 (Supp 1970).

Descriptors: *Oklahoma, *Water pollution, *Water pollution control, *Surface drainage, Surface waters, Surface runoff, Water pollution sources, Livestock, Pollutants, Water quality control, Domestic animals, Agriculture, Legal aspects, Legislation.

Each licensed feed yard operator is required by this statute to provide adequate drainage for surface waters; avoid pollution of any stream, lake, river, or creek; and provide reasonable methods for the disposal of animal excrement. (Madsen-Florida)

1202 - A3, A7, F2

OWENS V. UNITED STATES (LIABILITY OF UNITED STATES FOR NEGLIGENT APPLICATION OF INSECTICIDE, POLLUTING POND OF ADJACENT LANDOWNER).

294 F. Supp. 400-405 (S.D.Ala. 1968).

Descriptors: *Alabama, *Water pollution, *Insecticides, *Rainfall, Cattle, Ponds, Streams, Federal government, Administrative agencies, Rain, Legal aspects, Judicial decisions, Water pollution effects, Water pollution sources, Pollutants, Water wells, Damages, Remedies, Regulation.

Plaintiff cattle rancher sought to recover damages for injury to his herd from defendant United States under the Federal Tort Claims Act. Plaintiff's property included part of a small pond from which the cattle watered. The pond was supplied from rainfall and water drainage. A dry-bed drainage creek drained into the pond. Federal Department of Agriculture employees treated the property adjoining plaintiff's with a chemical insecticide. Thereafter, a heavy rainfall occurred which washed this insecticide into the dry-bed creek, and ultimately to plaintiff's pond. The pond was fenced off, and the cattle were not poisoned. Nevertheless, plaintiff claimed damages from loss of part of his pasture, reduced milk production, increased food cost, and the expense of drilling a well for water. Defendant contended that plaintiff's injury resulted from the rainfall, an act of God, and that it was not liable. The Federal District Court however, determined that under Alabama law an act of God would not render defendant immune where its negligence was also an acutal cause of plaintiff's injury. Since the court concluded that defendant's negligence was an actual cause of the injury, defendant was held liable. (Hart-Florida)

1203 - A2, A3, A4, F2

FOULING OF WATERS A MISDEMEANOR.

North Dakota Century Code Ann secs 61-01-12 thru 61-01-14 as amended (Supp 1969).

Descriptors: *North Dakota, *Water pollution sources, *Water pollution control, *Waste disposal, Water quality, Water quality control, Wastes, Industrial wastes, Refuse, Sewage effluents, Gasoline, Oil wastes, Farm wastes, Cattle, Sheep, Hogs, Sewage disposal, Streams, Rivers, Public health, Administrative agencies.

Section 61-01-12 provides that the fouling of public waters by depositing gas tars or other refuse from any gas house into streams, rivers or sewers that empty into public waters is a misdemeanor. Section 61-01-13 provides the fouling of public waters with dead animals, offal, or other refuse by depositing same on the banks or in any lake or stream within the jurisdiction of the state is a misdemeanor punishable by a fine of from $20 to $100. Section 61-01-14 provides that section 61-01-13 shall be construed to include: (1) privies and privy vaults; (2) any stable, shed, pen, yard, or corral where farm animals are located within sixty feet of the top of any lake or stream; and (3) any slaughterhouse, graveyard or cemetery within eighty feet of these waters. However, in an emergency, these provisions do not prevent any municipality from dumping untreated sewage into these waters provided they are not determined detrimental to public health. (Rees-Florida)

1204 - A2, F2

OHIO STOCK FOOD CO V GINTLING (STREAM POLLUTION BY UPPER RIPARIAN HOG FARM).

153 NE 341-345 (Ohio Ct App 1926).

Descriptors: *Ohio, *Municipal wastes, *Garbage dumps, *Pollution abatement, Water pollution, Wates disposal, Legal aspects, Judicial decisions, Streams, Hogs, Riparian water, Riparian land, Riparian rights, Farms, Farm wastes.

Defendant corporation owned a farm one mile from plaintiff's farm. Defendant, under contract with a municipulity, received the city's garbage and disposed of it by feeding it to hogs. A stream flowed through defendant's property, then passed through plaintiff's land. Plaintiff brought a nuisance action for damages, alleging that during the operation of its farm, defendant polluted the stream through drainage of liquid, filth and refuse. Defendant contended that its acts in the operation of its farm were authorized by law, inasmuch as it had a contract with a municipality to dispose of the garbage. The Ohio Court of Appeals held that plaintiff was liable for damages, notwithstanding the municipal contract. An upper proprietor of land cannot by artificial means pollute a stream to the injury of a lower riparian owner. (Powell-Florida)

1205 - A2, F1

SUMNER V O'DELL (INJUNCTION TO PREVENT POLLUTION OF SPRING WATER BY CATTLE).

12 Tenn App 496-500 (1930).

Descriptors: *Tennessee, *Water pollution, *Streams, *Reasonable use, Cattle, Domestic water, Riparian rights, Water quality, Spring waters, Springs, Legal aspects, Judicial decisions, Water pollution sources, Remedies, Relative rights.

Plaintiff lower riparian landowner sought to enjoin defendant upper riparian landowner from polluting the stream bordering their property. Plaintiff's and defendant's tracts were previously owned by one person, who conveyed plaintiff's tract first, along with the right to use the spring water flowing from defendant's tract. When defendant purchased the upper tract, he began using the lot through which the stream flowed as a confinement for cattle. The cattle polluted the water so that it was unfit for plaintiff's domestic uses. Apparently defendant's actions were purposeful, and with some malice, since the evidence presented clearly showed that defendant could have erected his fences to prevent pollution of the spring water. The Tennessee Court of Appeals held that defendant was utilizing his property unreasonably with respect to plaintiff's rights, and enjoined use of the lot as a cow pasture and path. (Hart-Florida)

1206 - A2, B1, F2

POLLUTION OF STREAMS.

Del Code Ann tit 16, secs 1301, 1302 (1953).

Descriptors: *Delaware, *Water pollution, *Streams, *Water pollution sources, Pollution abatement, Public health, Wastes, Industrial wastes, Water quality, Chemcontrol, Sewage, Organic wastes, Legislation, Judicial decisions, Water supply, Hogs, Water quality control.
Identifiers: Dye-stuffs, Slaughter houses.

No person shall discharge or allow any dye-stuffs, drugs, or chemicals which cause the stream to become noxious to the health or disagreeable to the senses to escape into any stream used as a water supply. In addition to imposing a fine for violation, the court shall also issue an abatement order within 20 days after conviction. The abatement shall be enforced by the sheriff. No person shall place a privy, hog-pen or slaughter house so as to pollute any stream with the excrement or offal therefrom. Violators shall be fined and the court shall order the nuisance abated immediately. (Helwig-Fla)

1207 - A2, B1, F2

FAIRES V DUPREE (WATER POLLUTION FROM ANIMAL WASTES).

197 SW 2d 735-738 (Ark 1946).

Descriptors: *Arkansas, *Hogs, *Animal wastes, *Water pollution, Cold springs, Farm wastes, Impaired water quality, Public health, Seepage, Damages, Legal aspects.
Identifiers: *Damages (Legal aspects).

Plaintiff brought action for damages resulting from the operation of a hog ranch in an unsanitary manner on land situated adjacent to plaintiff's property. The court found there was insufficient evidence to show an ascertainable monetary loss to plaintiff's spring from defendant's operation of a hog farm near plaintiff's land in such a manner that seepage from garbage washed down filling plaintiff's spring, polluting the water, and infecting it with maggots. However, evidence that plaintiff had periods of vomiting, nausea, and general debility presented a question for the jury as to whether plaintiff's illness was caused by the imposition of stench, flies, and filth or whether plaintiff was overstating the corrupting causes. Therefore, case was reversed and remanded for new trial. (Reed-Fla)

1208 - A3, F2

GREEN V MCCLOUD (ACTION TO ENJOIN SEWAGE FLOW).

303 Ky 267, 197 SW 2d 258-261 (1946).

Descriptors: *Kentucky, *Domestic wastes, *Water pollution, Prescriptive rights, Sewage sludge, Sewage effluents, Livestock wastes, Disposal, Farm wastes, Decomposing organic matter, Riparian waters, Dairy industry, Distribution systems, Nuisance (Water law), Legal aspects, Judicial decisions, Poultry.

Plaintiff brought suit to enjoin defendant from interfering with a sewer line which belonged to plaintiff and another. Defendant filed a counterclaim, consolidated with an action against two others to enjoin them from allowing sewage from residences and outbuildings to run through open ditches or buried pipes in the bed of small stream near defendant's property. From adverse judgments, defendant appealed. While there is no prescriptive right to maintain a nuisance, the fact that defendant moved onto the land upon which the nuisance existed is an important factor to be considered in determining the equities. The court found that the evidence authorized a finding that the sewer line emptying sewage from residences and outbuildings into the small stream did not constitute a nuisance which would be enjoined and consequently affirmed the judgments. (Reed-Fla)

1209 - A2, F2

ATKINSON V HERINGTON CATTLE CO (FEED LOT OPERATOR'S AND CATTLE OWNER'S JOINT LIABILITY FOR CATTLE WASTE RUNOFF).

436 P2d 816-828 (Kan 1968)

Descriptors: *Cattle, *Waste water (Pollution), *Damages, *Kansas, Water pollution sources, Farm wastes, Pollution abatement, Surface runoff, Water pollution effects, Water pollution control, Remedies, Legal aspects, Judicial decisions, Livestock, Stock water, Water supply, Water wells, Coliforms, Sewage bacteria, Nitrates.

In an action for damages arising from the pollution of plaintiff dairy farm owner's water supply by defendant cattle rancher's feeding operations, the Kansas Supreme Court held that the evidence was sufficient to support a judgment for actual, but not punitive, damages. The court agreed with plaintiff's contention that there was ample evidence to find that the waters of a creek and plaintiff's well were contaminated with coliform bacteria and nitrates following a runoff of rains from defendant's premises. The supreme court construed the lower court's ruling to mean that runoff becomes a harmful substance when it consists of contaminating bacteria and chemicals in such amounts as to produce excessive pollution which results in injury. The fact that a business is lawful does not exempt it from liability when contaminated or polluted water escapes onto the land of another in such quantities as to cause injury. The owner of the cattle being fed by defendant rancher was held jointly and severally liable since the bailment contract with defendant rancher vested essential control over the operation in the cattle owner-bailor. (Gallagher-Florida)

1210 - A2, A3, F1, F2

MEASURE AND ELEMENTS OF DAMAGES FOR POLLUTION OF A STREAM,
W. R. Habeeb
49 ALR 2d 253-314

Descriptors: *Judicial decisions, *Damages, *Water pollution, Reasonable use, Value, Market value, Depreciation, Economic rent, Water utilization, Odor, Trees, Crops, Recreation, Boating, Swimming, Fish, Livestock

Elements to be considered when measuring damages for stream pollution are examined. Where permanent or irreparable damage results, recovery may be had for the depreciation of market value of the property. However, where the damage can be remedied at a cost lower than the loss in market value, the cost of such repair becomes the measure of damages. Where the pollution is temporary or abateable, the measure is the depreciation in the rental or usable value of the property. Special damages may also be recovered, as may punitive damages, depending upon the particular circumstances. Particular items of damages such as impairment of use and enjoyment of property, noxious odors, discomfort and inconvenience, sickness, trees, crops, deprivation of use of water, recreation privileges, fish, death and injury of livestock, injury to business, expense of repairing injury, fencing, procuring water, expense of mill operations, and others are also examined. (S. Scott-Fla)

1211 - B1, C5

ELECTRIC POTENTIALS AND DOMESTIC WATER SUPPLIES,
Washington State Univ., Pullman.
L. B. Craine, M. H. Ehlers, and D. K. Nelson.
Agricultural Engineering, Vol 51, p 415-417, July 1970, 2 fig, 1 tab.

Descriptors: *Water supply, Agricultural engineering, *Cattle, Electrical grounding, Water consumption, Electrical networks, Electric currents.
Identifiers: *Electrical potential, Voltage.

Electric potentials on domestic water systems affected water consumption and productivity of cattle. The problem of annoying voltage resulted from a single-phase two-wire multiple-grounded system with primary distribution and secondary utilization neutrals solidly bonded together. The problem was solved by separation of grounded neutrals of the primary distribution system from the farm secondary system. An electrified fountain system was built to test effects of controlled water system voltages on animal water consumption. At current levels of 19 ma and at a level of 8 volts the cattle would not drink for an 8 hour period. (Galwardi-Texas)

1212 - A3, C4, C5

EFFECTS OF MULTIPLE USE ON WATER QUALITY OF HIGH-MOUNTAIN WATERSHEDS: BACTERIOLOGICAL INVESTIGATIONS OF MOUNTAIN STREAMS,
Montana State Univ., Bozeman. Dept. of Botany and Microbiology.
D. G. Stuart, G. K. Bissonnette, T. D. Goodrich, and W. G. Walter.
Applied Microbiology, Vol. 22, No. 6, p 1048-1054, December 1971. 6 fig, 2 tab, 15 ref.

Descriptors: *Water quality, *Watersheds, *Mountains, *Bacteria, *Water pollution sources, *Watershed management, Coliforms, Enteric bacteria, Cultures, Sampling, Nutrients, Montana, Recreation, Animal wastes, Streams, E. coli, Lumbering, Camping, Water supply, Wildlife, Chemical analysis, Salmonella, Pathogenic bacteria, Shigella, Filtration.
Identifiers: Enterobacter aerogenes, Hyalite watershed, Mystic watershed, Proteus, Streptococcus faccium var durans, Streptococcus faecalis var liquefaciens, Streptococcus bovis.

Bacteriological studies in 1968 and 1969 corroborated earlier findings that a municipal watershed which had been closed to public entry since 1917 yielded water with four to six times the coliform count found in an adjacent mountain watershed open to recreational activities. Similarly, chemical investigations showed higher concentrations of most ions in water from the closed area. Physiological differentiation of coliform and enterococcal bacteria revealed similar types of organisms in both animal droppings and stream, with fecal coliforms accounting for as much as 70 percent of the coliform counts observed in the closed area in 1969. Opening of the closed drainage for limited recreation and expanded logging operations in the spring of 1970 coincided with an unexpected decrease in bacterial contamination of that stream. It is postulated that these human activities drove from the watershed a large wild animal population which had contributed substantially to the previous bacterial pollution. It would seem that the practice of closing high-mountain watersheds to public entry is questionable if governmental standards for water quality are to be met, and it also seems that the standards themselves should be reexamined. (Jefferis-Battelle)

1213 - C4

A COMPUTER PROGRAM FOR IDENTIFYING MICROORGANISMS,
Quincy Coll., Ill.
W. Gasser, and K. M. Gehrt.
BioScience, Vol. 21, No. 20, p 1044-1045, October 15, 1971. 3 tab, 7 ref.

Descriptors: *Pathogenic bacteria, *Enteric bacteria, *Computer programs, Programming languages, *Pollutant identification, Microorganisms, Computer models, Automation, E. coli, Data processing, Pseudomonas, Salmonella, Streptococcus.
Identifiers: Proteus vulgaris, Pseudomonas aeruginosa, Alcaligenes faecalis, Serratia, Serratia marcesens, Salmonella typhosa, Klebsiella, Klebsiella pneumoniae, Staphylococcus, Staphylococcus aureus, Sarcina lutea, Diplococcus pneumoniae, Streptococcus pyogenes.

A computer program has been developed to identify microorganisms from test results. Results from standard microbiological tests (e.g. gram stain, glucose fermentation) are used in the program. Where many organisms are identified from limited test results, results from additional chemical tests may be entered for complete identification. Some of the advantages of the program are: ability to handle several sets of input data, easy program modification, and the need for minimal programming knowledge. An identification matrix is included for E. coli, Proteus vulgarus, Pseudomonas aeruginosa, Alcaligenes faecalis, Serratia marcesens, Salmonella typhosa, Klebsiella pneumoniae, Staphylococcus aureus, sarcina lutea, Diplococcus pneumoniae, Streptococcus pyogenes. (Mackan-Battelle)

1214 - A2, A3, A4, C5, F3

THE DISPOSAL OF AGRICULTURAL WASTE,
Douglas Gowan.
Effluent and Water Treatment Journal, p 303-308, June 1971. 2 tab, 10 ref.

Descriptors: *Waste disposal, *Farm wastes, Water pollution, Fertilizers, Farm management, Livestock, Economics, Copper, Arsenic compounds, Odor, Sewers, Biochemical oxygen demand, Slurries, Chlorides, Ammonia, Nitrogen, Dairy industry
Identifiers: United Kingdom, Farm income.

The present United Kingdom laws make it unlawful to discharge farm drainage into a stream without consent of river authorities; river authorities also have power to control pollution of underground water. Over 131,000 farm discharges to watercourses in the United Kingdom are known, the combined effect posing serious consequences. The basic need is cheaper methods of dealing with manure and other wastes from large animal concentrations. Cattle wastes have quite different characteristics from domestic wastes and chemical residues from feed additives can give rise to serious difficulties in the effects on biological treatment processes. To control odor of animal excreta, ammonium persulphate has proven effective. Farm wastes disposal onto land and into public sewers are discussed and population equivalents are considered. Every farm is different and must be treated individually for assessing charges for reception and treatment in the public sewer. Discharges from dairy farms and from mixed farms are tabulated. Today local authorities have the means of obtaining relatively accurate information for design of treatment plants as well as for the assessment of charges. (Jones-Wisconsin)

1215 - C3

AUTOMATED COMBUSTION VERSUS DIGESTION FOR TRITIUM MEASUREMENT IN BIOLOGICAL SAMPLES,
Agricultural Research Service, Kerryville, Tex. Toxicological Research Lab.
L. M. Hunt, and B. N. Gilbert.
International Journal of Applied Radiation and Isotopes, Vol 23, No 5, p 246-249, May 1972. 1 fig, 2 tab, 8 ref.

Descriptors: *Digestion, *Tritium, *Automation, Chemical analysis, Bioassay, Pollutant identification, Suspension, Quenching, Aqueous solutions, Animal wastes, Solvent extractions, Water pollution sources, Thiocarbamate pesticides, Sheep.
Identifiers: *Biological samples, *Combustion, Ferbam, Tissue, Recovery, Liquid scintillation, Sample preparation, Lungs, Pancreas, Bone, Heart, Brain, Spleen, Muscle, Liver, Kidneys, Feces, Blood.

In order to find the most feasible method for analyzing tritium-tagged biological samples, the more frequently used techniques for noncombustion preparation, digestion, suspension, and extraction were compared with the automated combustion method. Sheep tissues were collected and prepared, and ferbam, a dithiocarbamate fungicidal compound, was used for recovery determinations. With the automated combustion method, the mean recovery for the first eight tissues at the 25 milligram level was 95 percent compared to 69 percent using digestion. When the sample sizes were increased, a notable difference in the comparison was apparent, as the percentage recovery was 82 percent for combustion and 40 percent by digestion. It appeared that digestion rather than combustion of the 25 milligram muscle samples was superior. No corrections were made for quenching in order to get a true comparison of the two methods of analysis. The disparity in methodology became marked with sample sizes of 50 and 100 micorliters with combustion maintaining a high efficiency, while digestion significantly decreased as sample size increased. Combustion had the advantage of speed (8-10 minutes per sample) with no clean-up between combustions. (Byrd-Battelle)

1216 - C3

IDENTIFICATION OF METABOLITES OF N - (1, 1-DIMETHYLPROPYNYL) - 3,5 DICHLORBENZAMINE IN RAT AND COW URINE AND RAT FECES,
Rohm and Haas Co., Springhouse, Pa., Research Labs.
Roy Y. Yih, and Colin Swithenbank.
Journal of Agricultural Food Chemistry, Vol. 19, No. 2, 1971 p 320-324, 3 fig., 3 tab., 7 ref.

Descriptors: *Farm wastes, Laboratory tests, Chemical analysis, Metabolism, Radioactivity techniques, *Pollutant identification.
Identifiers: *Metabolic pathways, Chemical structure, Metabolites.

This is the continuation of studies to determine the comparative metabolism of N- (1,1-dimethylpropynyl)-3,5-dichlorobenzamide in soil, plants, and animals. Nine metabolites were identified in soil and alfalfa treated with this compound. This study concerns the isolation, identification and synthesis of these metabolites in rat and cow urine and rat feces. Tentative metabolic pathways and its comparative metabolism in soils, plants, and mammals are postulated. (Christenbury-Iowa State)

1217 - A2, A3, C4

APPLYING BACTERIOLOGICAL PARAMETERS TO RECREATIONAL WATER QUALITY,
E. Geldreich.
Journal of the American Water Works Association, Vol 62, No 2, p 113-120, Feb 1970. 8 p, 53 ref.

Descriptors: *Recreation, *Bioindicators, *Water quality, *Bacteria, Aquatic bacteria, Aquatic microbiology, Aquatic microorganisms, Coliforms, Salmonella, Streptococcus, Water pollution, Water pollution sources, Pollutant identification, Path of pollutants, Animal wastes (Wildlife), Public health, Standards, Farm wastes, Water zoning, Sediment-water interfaces, Domestic wastes, Legal aspects, Sewage bacteria, Pathogenic bacteria.
Identifiers: *Fecal pollution.

Fecal contamination from all warm-blooded animals is the natural link to pathogenic microorganisms in polluted water. The fecal coliform test accurately detects and measures such fecal contamination. Use of the fecal coliform test as a measure of recreational water quality is recommended. Data and tables are given to show a correlation between fecal coliform and the probable occurance of Salmonella, an easily detecting pathogen. Court hearings are cited that establish the legal status of the fecal coliform test. The water-sediment interface of a stream or lake bottom can serve as a reservoir for fecal pollution 'fallout' from overlying water. The fecal-streptococcus group's diverse survival rates and specific fecal origins make them specific indicators for nonhuman, warm-blooded, animal pollution. Various minimal bacterial densities are suggested to insure good recreational water quality. (Cuevas-Florida)

1218 - A2, A3, A4, A9, F4

FUTURE WATER QUALITY DESIGN,
California State Department of Public Health, Berkeley.
Frank M. Stead.
Journal of the American Water Works, Vol. 59, No 12, December 1967, pp. 1497-1501.

Descriptors: Water quality, *Water pollution, *Water quality management, Stream conditions, Standards, Industrial wastes, Public health, Water pollution sources, Municipal wastes, *Waste water disposal, Benefits.
Identifiers: Pathogens, Pesticide pollutions, Total management, Aquatic system.

Pollution control alone will not preserve water quality in the U.S. because it is based on a concept of disposal of wastewaters from municipalities and industries. In both cases the sewage is no longer wanted, and most often put back into the rivers. With half the total annual water replenishment put to use and converted to wastewater, it is important to consider how much dilution is necessary to keep waters up to present standards. There are three basic choices: (1) discharge the entire waste stream to the ocean or evaporate it, (2) through treatment bring the wastewater up to a sufficient level of quality so that when it is diluted it meets standards for all uses, (3) through treatment bring each individual waste stream up to the standard of quality for a specific use and put resulting 'reclaimed' water to that use directly, without returning it to either surface or ground waters. Current standards concerning pathogens and pesticides have not been given enough study to really indicate possible impairment of human health. What is needed is a new water policy for the U.S. -a policy involving total management of water resources. The entire aquatic system must be analyzed and a new system of distribution in terms of benefits must be devised. (Gargola-Chicago)

1219 - A2, A3, A4, A9, F4

NITRATES IN THE ENVIRONMENT,
Wisconsin Univ., Madison. Dept. of Civil Engineering.
M. Starr Nichols.
Journal American Water Works Association, Vol 57, No 10, p 1319-1327, 1965. 25 ref.

Descriptors: *Nitrogen, *Atmosphere, *Biosphere, Fertilization, Nitrogen fixation, Denitrification, Wastes, Nitrogen fixing bacteria, Ammonia, Odor, Aquatic plants, Groundwater, Toxicity, Waste treatment.
Identifiers: Nitrogen deposits, Mineralization, Methemoglobinemia, Livestock poisoning, Silage gas, Odor prevention.

Atmospheric nitrogen, supplying 1600 pounds of elemental nitrogen per square foot of the world, is the most important source of nitrogen fertilizer. Nonsymbiotic and symbiotic nitrogen-fixing organisms fix nitrogen in the biosphere from atmospheric supplies. These organisms include 10 species of bacteria and 6 strains of blue-green algae. Denitrifying organisms cycle nitrogen back to the atmosphere. Nitrifying organisms, such as Nitrobacter, oxidize organic nitrogenous compounds in waste matter to nitrate after ammonification occurs. Mineralization of nitrogen in waste matter is responsible for most nitrogen mineral deposits found in the world. Slightly alkaline buffered environment and aerobic conditions will produce nitrates at enormous rates to supply nutrient needs. Aquatic growths in lakes from overfertilization may be nature's method of conserving nitrogen fertilizer. Presence of nitrogen compounds can indicate pollution. Nitrate concentration above 45 ppm might cause methemoglobinemia. Livestock is susceptible to nitrate poisoning. Sodium nitrate added to waste treatment lagoons limits odors and enhances biochemical oxygen demand reduction. Nitrates are added to natural water by leaching and runoff from wastes and poorly managed fertilizing practices. (Bannerman-Wisconsin)

1220 - A3, A4, A7, A9, F4

WATER POLLUTION RESULTING FROM AGRICULTURAL ACTIVITIES,
Clemson Coll., S.C. School of Agriculture.
H. J. Webb.
Journal of the American Water Works Association, Vol 54, No 1, p 83-87, January 1962. 2 tab, 10 ref.

Descriptors: *Water pollution sources, *Farm wastes, *Pesticides, *Farm lagoons, *Fertilizers, Chlorinated hydrocarbons, Nitrates, Insecticides, DDT, Sewage lagoons, Waste disposal, Fertilization, Farm management, Crop production, Lime, Phosphates, Livestock, Hogs, Confinement pens, Fish, *Feed lots.

Farm practices are changing to grow more crops on less land, and produce more animals in a smaller area. More fertilizers and pesticides are needed to do this with the result that water quality is affected. Animal wastes will increasingly be a problem in terms of disposal and treatment. Feed yard waste treatment facilities often lack adequate design. Pesticides, especially the chlorinated hydrocarbons, pose increasingly serious problems for fish life. Traditional treatment methods are not effective in removing many of these pollutants from domestic water supply systems. More research and information is needed on the effects of the evolving farm practices on water quality. (Plack-AWWARF)

1221 - C3

DETERMINATION OF MERCURY IN FOOD PRODUCTS AND BIOLOGICAL FLUIDS BY AERATION AND FLAMELESS ATOMIC ABSORPTION SPECTROPHOTOMETRY,
Michigan Dept. of Agriculture, Lansing.
V. A. Thorpe.
Journal of the Association of Analytical Chemists, Vol. 54, No. 1, p 206-210, 1971. 3 fig, 4 tab, 4 ref.

Descriptors: *Mercury, *Pollutant identification, Foods, Fish, Chemical analysis, Acids, Chemical reactions, Oxidation, Feeds, Milk, Poultry, Reduction (Chemical), Calibrations, *Aeration.
Identifiers: *Biological samples, Potassium permanganate, Stannous chloride, Sulfuric acid, Reagents, Blood, Urine, Meat, Eggs, *Atomic absorption spectrophotometry, Precision, Sample preparation, Chemical recovery.

A modification of a method developed at the Fisheries Research Board of Canada has been used for determining mercury in fish, water, other food products, and biological fluids such as meat, poultry, eggs, milk, urine, blood, and animal feeds. Samples were wet digested at 50 C with sulfuric acid, oxidized with strong potassium permanganate solution, and reduced with stannous chloride. Flameless atomic absorption spectrophotometry was used to measure vapor, and to compare sample results with prepared standards and standard curves. Replication of analyses on different days showed good precision, and in testing samples spiked with known amounts of mercury results showed adequate recovery. (Mackan-Battelle)

1222 - C2, C3, C4

PEPSIN DIGESTIBILITY METHOD FOR ANIMAL PROTEINS. 1971 COLLABORATIVE STUDY,
Moorman Mfg. Co., Quincy, Ill.
A. J. Gehrt.
Journal of the Association of Official Analytical Chemists, Vol 55, No 4, p 702-706, 1972. 1 tab, 4 ref.

Descriptors: *Digestion, *Filtration, *Analytical techniques, *Protein, Centrifugation, Poultry, Nitrogen compounds, Organic compounds, Chemical analysis, Methodology, Quality control.
Identifiers: *Pepsin, *Interlaboratory tests, Collaborative studies, Biological samples, Method validation, Data interpretation.

Twenty collaborating laboratories evaluated a new method of filtering residues from a pepsin digestibility test of animal proteins. When the first action method was modified by more detailed filtering instructions, the analysts found increased sensitivity and reproducibility. Based on the data from the collaborative studies the method has now been adopted as official first action for poultry byproduct meal and hydrolyzed feathers and as final action for other animal proteins. (Mortland-Battelle)

1223 - A2, A7, A9

EFFECT OF DURSBAN IN THE DRINKING WATER OF CHICKS,
Manitoba Univ., Winnipeg. Dept. of Entomology.
R. A. Brust, S. Miyazaki, and G. C. Hodgson.
J Econ Entomol. Vol 64, No 5, p 1179-1183. 1971. Illus.
Identifiers: *Poultry, Blood, *Dursban, Cholin esterase, Water pollution effects.

The insecticide Dursban (0,0-diethy 0- (3,5,6-trichloro-2-pyridyl) phosphorothioate), was added to the drinking water of young Leghorn cockerels at 8 levels ranging from 0.08 to 1280 ppm active ingredient. Experiments were begun with chicks 3 or 5 days old and were concluded after 3 and 4 wk. Mortality at 80 ppm was 20%, and mortality at 320 and 1280 ppm was 100%. No adverse effects were apparent at lower levels. Solvent and inert ingredients of Dursban emulsifiable concentrate had no adverse effect on the chicks up to 717.7 ppm. Cholinesterase activity in whole blood was monitored at all treatment levels, and the activity decreased at 80 ppm Dursban and above. At lower levels there was no significant difference from the controls. Weight gain/day diminished with increased levels of Dursban. Starvation of treated chicks did not affect blood-cholinesterase activity.–Copyright 1972, Biological Abstracts, Inc.

1224 - A3, A4, B1, C4, C5

FACTORS AFFECTING THE CONCENTRATION OF FAECAL BACTERIA IN LAND--DRAINAGE WATER,
West of Scotland Agricultural Coll., Auchincruive (Scotland). Dept. of Microbiology.
M. R. Evans, and J. D. Owens.
Journal of General Microbiology, Vol 71, No 3, p 477-485, August 1972. 4 fig, 8 ref.

Descriptors: *Drainage water, *Farm wastes, *Environmental effects, *Subsurface drainage, *Enteric bacteria, Subsurface waters, Hogs, Flow rates, Equations, Water pollution sources, Percolation, Soil water movement, Seepage, Pollutant identification, Biochemical oxygen demand, E. coli, Filtration, Membranes, Discharge (Water), Weir gauges, Clay loam, Sands, Surface runoff.
Identifiers: Enterococci, Biochemical tests, Fecal coliforms.

The rate of discharge and the concentration of faecal bacteria in the water from a subsurface field drain were monitored by standard techniques initially for one winter without application of animal excrement to the pasture, and, subsequently, for two winters when pig excrement was sprayed over the pasture. The concentrations of Escherichia coli and enterococci in the water were affected by three main factors: the flow rate of the drain discharge; the number of bacteria in or on the soil and vegetation; and the application to the land of large volumes of semiliquid animal excrement over short periods of time. In the absence of excrement application, the concentration of faecal bacteria in the water was related to the flow rate and to time by an equation of the form: log bacterial concentration equals a plus b log flow rate minus c days, where a, b and c are constants. The concentrations of bacteria in the water declined with time, the 90 percent reduction times being 57 days for E. coli and 96 days for enterococci. The spraying of pig excrement over the pasture resulted in a 30- to 900-fold increase in the concentrations of faecal bacteria in the drain discharge within 2 h of the start of the spraying. The concentrations of faecal bacteria returned to their normal levels over a period of 2 to 3 days. (Byrd-Battelle)

1225 - A2, A3, F3

CONSERVING RESOURCES AND MAINTAINING A QUALITY ENVIRONMENT,
Agricultural Research Service, Beltsville, Md. Soil and Water Conservation Research Div.
Cecil H. Wadleigh, and Clarence S. Britt.
Journal of Soil and Water Conservation, Vol 24, No 4, p 172-175, Oct 1969. 4 p, 4 ref.

Descriptors: *Water resource development, *Water pollution, *Eutrophication, Government supports, Soil conservation, Industrial wastes, Municipal wastes, Fertilizers, Pesticides, Soil erosion, Animal wastes, Economics, Nitrogen, Water conservation.
Identifiers: *Soil runoff, Livestock.

Some of the problems involved in natural resource conservation are presented, with particular emphasis on the water pollution caused by agricultural runoff and livestock production. It is pointed out that the economics of the farming and livestock industry are often in conflict with the conservationists' interests. It is suggested that the Dept of Agriculture adopt a cost-sharing program to encourage solutions to some of the problems. The article emphasizes the dangers of eutrophication induced by animal wastes. The author concludes with a statement of some of the accomplishments of the conservation movement in the area of soil and water resources. (Murphy-Rutgers)

1226 - A2, A4, C3

PHOSPHORUS AND WATER POLLUTION,
Agricultural Research Service, Beltsville, Md. Soils Lab.
Alan W. Taylor.
Journal of Soil and Water Conservation, p 228-231, November-December 1967. 4 tab, 26 ref.

Descriptors: *Phosphorus, *Groundwater, *Water pollution sources, Sewage effluents, Eutrophication, Irrigation, Water pollution control, Water chemistry.
Identifiers: Manure, Feedlots, Phosphorus sources, Agricultural fertilizers.

Phosphorus, an important nutrient in natural water, will stimulate excess growth at 0.05 ppm. It is quickly converted to insoluble form in soil and strong sorbtion by soil particles almost completely immobilize it. Pollution from groundwater phosphorus is therefore minimal even though irrigation drainage may cause phosphorus concentration of .08 ppm in groundwater. Eroding topsoils can contribute phosphorus to natural water. Unlike spasmodic erosion flow, manure in stockyards and manure piles supply a steady flow of relatively high phosphorus concentration in available form. Phosphorus pollution from feedlots is significant because concentration of output. Measuring total phosphorus concentration in a water body does not indicate phosphorus available for growth, which is a small fraction of the total. Continuous monitoring of total and available phosphorus concentrations are necessary to assess nutrient sources. One pound of phosphorus dissolved in one acre-foot of water yields a concentration of 0.03 ppm. Phosphorus contamination from sewage effluent is significant, based on a per capita consumption of 2.5 lbs of phosphorus. (Bannerman-Wisconsin)

1227 - F4

AGRICULTURAL (LIVESTOCK) WASTES (LITERATURE REVIEW),
Water Pollution Control Federation, Washington, D.C.
J. R. Miner.
Journal of the Water Pollution Control Federation, Vol 42, No 6, p 1171-1179, June 1970. 59 ref.

Descriptors: *Agriculture, *Industrial wastes, *Waste water treatment, Odors, Cattle, Crops, Biological treatment, Dairy industry, Poultry.
Identifiers: Manure, Feed lots.

Recent literature concerning agricultural waste disposal is reviewed. The problems associated with water pollution control related to cattle feed lot runoff were discussed in relation to the characteristics, handling, treatment, utilization, disposal and odor problems of livestock manure. A review of research pertaining to swine waste management includes discussioms of manure properties, application to cropland, treatment technology, alternatives for disposal or utilization, and gases and odors related to manure storage. The production, value, use, and disposal of poultry manure is also included. The value of poultry manure as a fertilizer for specific crops is discussed. A great deal of study has been made on the gases and odors evolved from manure decomposition and a court case is sited in which an award of $36,000 was made due to water pollution and odors. Some wastes which are characterized are from steer, sheep, poultry, and storm runoff from a variety of cropland. A great deal of study was done on cattle feed lot wastes and various methods of treatment. The application of partly treated livestock wastes to cropland has been of growing interest. The largest problem occurring with this type of disposal is the contamination of the groundwater by nitrogen mostly in the form of nitrates. A variety of biological treatment processes were studied including lagoon, aerated lagoons, extended aeration, anaerobic digestion, and aerobic digestion. (Hancuff-Texas)

1228 - B1, D1, E1

ALTERNATIVES FOR THE TREATMENT AND DISPOSAL OF ANIMAL WASTES,
Cornell Univ., Ithaca, N.Y. Dept. of Civil and Agricultural Engineering.
Raymond C. Loehr.
Journal Water Pollution Control Federation, Vol 43, No 4, p 668-678, 2 fig, 2 tab, 10 ref.

Descriptors: *Farm wastes, *Disposal, *Treatment, *Systems analysis, Runoff, Pollutant, Nutrients, Aerobic treatment, Anaerobic digestion, Dentrification, Nitrification, Effluents, Legal aspects, Waste water treatment, Waste disposal.
Identifiers: Options, Land disposal, Oxidation ditch, Pollutional characteristics alternatives.

The various systems for treating wastes from enclosed confined animal production operations are discussed. There is no one process or waste management system that will be adequate for all animal production operations. Aeration systems such as oxidation ditches are gaining acceptance for waste handling and treatment. It is unlikely that current liquid waste treatment systems for treating concentrated animal waste water will produce effluents that can be discharged to surface water. Land disposal is an integral part of feasible animal waste treatment systems. (Christenbury-Iowa State)

1229 - C5, D4

ANAEROBIC LAGOON TREATMENT OF MILKING-PARLOR WASTES,
Kansas Univ., Lawrence. Dept. of Civil Engineering.
Raymond C. Loehr, and John A. Ruf.
Journal of the Water Pollution Control Federation, Vol 40, No 1, p 83-94, Jan 1968. 5 fig, 4 tab, 14 ref.

Descriptors: *Anaerobic conditions, *Industrial wastes, *Lagoons, Dairy industry, Animals, Biochemical oxygen demand, Coliforms, Efficiencies, Sewage treatment, Sludge, *Waste water

treatment.
Identifiers: *Dairy cattle, *Field study, Milking parlor, Waste characteristics.

A field study of an 80-cow milking parlor and its waste treatment facilities determined that the average flow and BOD5 of the milking parlor waste were 760 gpd (2870 l/d) and 1030 mg/l. The flow varied considerably through the day. The first cell was loaded at 9 lbs BOD5/d/1000 cuft (144 g BOD5/d/cu m). The summer BOD reduction was 85% while during the winter it was only 70%. The BOD5 of the supernatant from the second cell during the summer ranged from 50 to 100 mg/l. Removal of solids from the lagoons during cold weather adversely influenced the performance of the lagoons. Solids assumulated in the first cell during winter and were degraded during spring. Coliform reductions in the system exceeded 99%. (Aguirre-Texas)

1230 - B1, D4, F4

LAGOONS AND OXIDATION PONDS (Literature Review),
W. C. Boyle.
Journal of the Water Pollution Control Federation, Vol 42, No 6, p 910-916, June 1970. 39 ref.

Descriptors: *Waste water treatment, *Lagoons, *Ponds, Oxidation, Biological treatment, Sewage treatment, Aeration, Temperature, Industrial wastes, Nutrients, Coliform, Efficiency, Poultry, Tertiary treatment.

A review of the 1969 literature on lagoons and oxidation ponds is presented. The review includes discussion of principles of aerated lagoon design. A pilot plant study to treat box-board white water and paper-board mill waste waters is outlined. Discussion of several full scale aerated lagoons is presented and includes the design and cost of treatment. A variety of industrial wastes are treated through pond and lagoons: Kraft mill wastes, pulp and paper mill wastes, refinery and chemical wastes, poultry wastes, hog slaughter house wastes, animal wastes, dairy manure wastes and phenolic wastes. Data are presented on the design, power requirements, organic loadings, efficiencies, effects of temperature, aeration requirements, nutrient requirements, coliform and pathogen removals and influence of detergents. The use of ponds as tertiary process is also discussed for a variety of wastewaters. (Hancuff-Texas)

1231 - A3, F4

POLLUTION AND EUTROPHICATION PROBLEMS OF GREAT SOUTH BAY, LONG ISLAND, NEW YORK,
New York State Dept. of Conservation, Ronkonkoma.
Jack Foehrenbach.
J Water Pollut Contr Federation, Vol 41, No 8, Part 1, p 1456-1466, Aug 1969. 11 p, 4 fig, 1 tab, 16 ref.

Descriptors: *Eutrophication, *Bays, *Farm wastes, Poultry, Water pollution sources, Water pollution effects, Dissolved oxygen, Oxygen demand, Streamflow, Sport fishing, Commercial fishing, Recreation, Ecology, Economics, Fisheries, Pesticides, Waste water disposal.
Identifiers: *Great South Bay, Long Island (NY).

Great South Bay is located midway between New York City and Montauk Point. Each year sport fisheries gross $4,539,000. In addition, 53,400 lb of finfish ($12,000) and 4,792,000 lb of shellfish ($4,250,000) are harvested. Because of poor recirculation and small inflow of tidal waters, the creek flows of 24 million cu ft/day and groundwater flows of 28 million cu ft/day are helping to increase the nutrient content of the 92-sq mile bay, much of which is less than 8 ft deep. Although the bay has a large assimilative capacity for some forms of pollution, it is reaching a point where additional loads will affect adversely its ecology, economic, and recreational value. (Knapp-USGS)

1232 - C2, C3, C4, F5

WASTE WATER FROM SIMIAN PRIMATE FACILITIES,
Tulane Univ., Covington, La. Delta Regional Primate Research Center.
E. W. Fritschi, and F. W. Macdonald.
Journal Water Pollution Control Federation, Vol 43, No 5, May 1971, p 883-889.

Descriptors: *Laboratory animals, *Waste water treatment, Design criteria, Sampling, Analytical techniques, Evaporation, Biological oxygen demand, Urine, Coliforms, Pathogenic bacteria, Animal parasites, Disinfection, Chlorination, Louisiana, *Treatment facilities.
Identifiers: *Primates, *Bacteriological analyses, Feces.

Water and waste water balances were performed on the Delta Regional Primate Research Center in Covington, Louisiana. Total input of both food and water was measured for selected animals and urine, feces, and vomitus of the animals were also collected and analyzed. Average food consumption was 3.0% of body weight, and an estimated 50% of the food is wastes. Measurement of the BOD of the collected waste materials established primate wastes as being 3 to 6 times higher in BOD than conventional municipal wastes. No correlation of total solids with genera, age, weight, or sec of the animals was discovered. Primate feces were found to be cruder than human feces, also and considerable difficulty in finding a suitable feed for the dilution water. Further study of this phenomenon has been planned. Monitoring of daily water usage revealed a fairly constant flow. There was little daily fluctuation in cage washwater, since the animal population was fairly constant, and all cages had to be washed. Bacteriological analysis revealed a wide variety of organisms including several nonspecific parasites and numerous pathogens. This discovery neccessitated that particular attention be given to chlorination and disinfection. (Lowry-Texas)

1233 - A2, A4, C3, E2

LOSSES OF NITROGEN AND PHOSPHORUS FROM AGRICULTURAL LAND,
Rothamsted Experimental Station, Harpenden (England).
G. W. Cooke, and R. J. B. Williams.
Journal of the Society for Water Treatment and Examination, Vol 19, Part 3, p 253-276, 1970. 7 tab, 34 ref, discussion.

Descriptors: *Water pollution sources, *Nitrogen, *Nitrates, *Agricultural watersheds, Phosphorus, Leaching, Soils, Drainage, Lysimeters, Fertilizers, Rainfall, Model studies, Analytical techniques, Arable land, Grasslands, Clays, Liquid wastes, Livestock, Solubility, Phosphates, Subsoil, Domestic animals, Erosion, Wind erosion, Suspended load.
Identifiers: *United Kingdom, Plowing, Nitrogen losses.

Nitrogen and phosphorus is introduced to water supplies by leaching of drainage water through agricultural land, by liquid wastes from stockyards and surface runoff from saturated or frozen soil, by movement of fine soil particles down profiles and entering drainage systems, and by erosion of surface soil by wind and water. Drainage from well farmed arable land in England contains, on the average, 10 mg/l of nitrate-nitrogen. Nitrate loss in drainage from productive land cannot be prevented because more nitrogen will be mineralized from soil reserves and crop residues by microbial action than arable crops can absorb at times. Drainage passing through permeable subsoils to deep water tables carries nitrate that persists in the water. Soluble phosphate fertilizers leach down soil profiles in podzols developed from Bagshot beds which contain only 1-2% clay in the surface while insoluble phosphates are better retained in these topsoils. Phophorus in manure applied in large amounts annually for 20 years penetrated the subsoil of light land at Woburn, the only example of soluble phosphates in arable soils reaching drainage systems. Watercourse contamination may occur where stock are kept on small areas. (Jones-Wisconsin)

1234 - A2, B1, C2, C3, C4

SOME OBSERVATIONS ON THE LIMNOLOGY OF A POND RECEIVING ANIMAL WASTES,
Oklahoma State Univ., Stillwater. Dept. of Zoology.
Dale W. Toetz.
Proceedings Oklahoma Academy of Science, Vol 51, p 30-35, 1971. 4 fig, 2 tab, 11 ref.

Descriptors: *Oxidation lagoons, *Water pollution effects, *Farm wastes, Oklahoma, Cyanophyta, Chlorella, Ions, Phytoplankton, Nitrates, Nitrogen fixation, Algae, Conductivity, Chlorophyll, Pigments, Dispersion, Runoff.
Identifiers: *Feedlots, Lemna.

A small pond receiving runoff from a hog yard was dominated by a large population of blue-green algae and phytoflagellates during summer and by Chlorella sp during winter. Heavy rainfalls decreased the ionic concentration of water and altered the phytoplankton composition. Occasional concentration of oxygen below 5 mg/l and high ammonia content suggested that the pond is unsuitable for warm-water fish culture. (Wilde-Wisconsin)

1235 - A2, C4

BOD DETERMINATIONS ON FEEDLOT RUNOFF,
Nebraska Univ., Lincoln. Dept. of Civil Engineering.
T. J. McGhee, R. L. Torrens, and R. J. Smaus.
Water and Sewage Works, Vol 119, No 6, June 1972, p 58-61. 7 fig, 1 tab, 20 ref. OWRR A-022-NEB (2).

Descriptors: *Analytical techniques, *Biochemical oxygen demand, *Pollutant identification, *Cattle, Organic matter, Chemical oxygen demand, Oxygen demand, *Feedlots, *Farm wastes.
Identifiers: *Cattle feedlot runoff, Ultimate BOD.

During laboratory studies of the aerobic treatment of feedlot runoff it was observed that significant reductions in the COD of the waste were not reflected in a similar reduction in BOD as determined by the standard 5-day tests. The rate at which the oxygen demand was exerted, the duration of the BOD test necessary to actually measure the pollution effect of such wastes and the general applicability of the standard BOD test to feedlot wastes were investigated. It was concluded that the standard 5-day BOD determination was not an adequate measure of the pollution potential of feedlot runoff as feedlot runoff contained slowly degradable organic materials which would exert a significant oxygen demand over periods in excess of 20 days. The chemical oxygen demand test was a superior technique although it usually yielded higher results than the actual ultimate BOD. (Galwardi-Texas)

1236 - A4, C4

MIGRATION OF POLLUTANTS IN A GLACIAL OUTWASH ENVIRONMENT,
Washington State Univ., Pullman.
James W. Crosby, III, Donald L. Johnstone, and Robert L. Fenton.
Water Resources Research, Vol 7, No 1, p 204-

208, February 1971. 5 p, 5 fig, 11 ref. OWRR Project B-005-WASH (3).

Descriptors: *Path of pollutants, *Glacial drift, *Farm wastes, *Confinement pens, Coliforms, Nitrates, Nutrients, Solutes, Soil water movement, Groundwater, Washington, Water pollution sources, Chlorides, Soil moisture.
Identifiers: Feedlots(Cattle), Outwash (Glacial).

A test drilling program was conducted at a dairy in the Spokane Valley, Washington, to determine the effects of feedlot operation on groundwater quality. Coliform bacteria, enterococci, and fecal coliforms were found to disappear within a relatively few feet of the ground surface. Chlorides and nitrates, however, were persistent in depth and may actually reach the groundwater body. The low natural moisture content of the soil, coupled with the apparent high moisture tensions, suggests that soil moisture is not presently moving downward in the system. It is concluded that the downward migration of inorganic chemicals from the feedlot environment must represent an early phase of the operation, which is arrested as organic mattes are formed in near-surface layers. (Knapp-USGS)

1237 - A2, B1, C1

POLLUTION POTENTIAL OF SALMONID FISH HATCHERIES,
Kramer, Chin and Mayo, Seattle, Wash.
Paul B. Liao.
Water and Sewage Works, Vol 117, No 12, p 291-297, 1970. 6 fig, 3 tab, 15 ref.

Descriptors: *Water pollution sources, *Fish hatcheries, *Salmonids, Water requirements, Temperature, Nutrients, Algae, Weeds, Taste, Odor, Pathogenic bacteria, Organic wastes, Solid wastes, Chemicals, Michigan, California, Tubificids, Colorado, Water pollution control, Washington, Chemical oxygen demand, Biochemical oxygen demand, Dissolved oxygen, Hydrogen ion concentration, Ammonia, Nitrates, Phosphates, Suspended load, Dissolved solids, Effluents.
Identifiers: Settleable solids, Hatchery effluents, Parasites, Jordan River (Mich), San Joaquin River (Calif), Rifle Falls (Colo), Fish fecal wastes, Residual food, Green River (Wash), Cowlitz Trout Hatchery (Wash).

Water pollution problems associated with salmonid hatchery operations include nutritional enrichment, algae and weed growth, taste, odor, settleable solids, pathogenic bacteria, parasites, organic matter, chemicals and drugs. Fish fecal wastes and residual food are most serious because they are encountered continuously under normal operating procedures; after field testing, these wastes are classified into organic, nutrient and solid pollutants. The average biochemical oxygen demand (BOD) concentration of hatchery effluents during pond cleaning is several times greater than during normal operation; closely related to BOD, is the dissolved oxygen level. The nutrient pollutants, nitrate and phosphate, are end-products of decomposition of fish food. The hatchery effluent tested may stimulate algal growth and cause algal blooms under certain conditions. The high percentage of suspended and settleable solids indicates that most solids in the cleaning water will be deposited on the stream bottom below the hatchery. Proper feeding would greatly reduce rate of pollutant production. The pollution potential of hatchery cleaning water is comparably to domestic sewage when diluted with infiltration water. Hatchery operating improvements should include proper fish loading techniques, proper feeding procedures, and water supply adjustments. (Jones-Wisconsin)

1238 - B1, D2, D4, E3

CLOSED SYSTEM WASTE MANAGEMENT FOR LIVESTOCK,
Michigan State Univ., East Lansing. Dept. of Agricultural Engineering.
P. O. Ngoddy, J. O. Harper, R. K. Collins, G. D. Wells, and F. A. Heidar.
Copy available from GPO Sup Doc EP2.10:13040 DKP 06/71, $1.25; microfiche from NTIS as PB-211 022, $0.95. Environmental Protection Agency, Water Pollution Control Research Series, June 1971, 110 p, 28 fig, 21 tab, 19 ref. EPA Program 13040 DKP 06/71.

Descriptors: *Farm wastes, *Water reuse, *Separation techniques, Screens, Suspended solids, Particle size, Sludge, Odor, Economic feasibility, Technical feasibility, Performance, Cattle, Hogs, Analytical techniques, *Waste water treatment.
Identifiers: *Waste management.

A vibrating screen separator has been developed for liquid-solid separation of livestock wastewater. Pilot tests on swine and beef cattle wastewater have shown that the resistant or slowly biodegradable solids are effectively removed on vibrating screens ranging in mesh size from no. 60 to no. 120. Although measurably less efficient than conventional dewatering devices such as centrifuges and vacuum filters, the gravity dewatering vibrating screen separation is better suited to the economic scale of the average livestock operation. The removal of resistant solids from wastewater prior to stabilization substantially improves the performance of biological treatment systems by enhancing the controlling transport and kinetic mechanisms in such processes. Screened solids are odorless, stable, and storable over long periods without an odor nuisance or pollutional problem. The liquid fraction can be partially reclaimed by biodegradation and recycled as transport water. A number of candidate livestock waste management designs integrating the salient features of the study have been proposed. (Lowry-Texas)

1239 — A4, B1, D4

DRAIN INSTALLATION FOR NITRATE REDUCTION,
Southwestern Irrigation Field Station, Brawley, California; Soil Conservation Service, Fresno, California; and U. S. Bureau of Reclamation, Sacramento, respectively.
L. S. Willardson, B. D. Meek, L. E. Grass, G. L. Dickey, and J. W. Bailey.
Paper presented at the 1969 Winter Meeting, American Society of Agricultural Engineers, Chicago, Illinois, December 9-12, 1969, Paper No. 69-734, 8 p., 2 tab., 2 fig.

Descriptors: *California, *Drains, *Installation, *Nitrates, Permeability, Sumps, *Irrigation, Electrical conductance, Leaching, Percolation, *Groundwater, *Denitrification.
Identifiers: *San Joaquin Valley, Panoche silty clay.

Because farmers remove more nitrates from the soil than they put into it, denitrification or reducing nitrates to nitrogen gas, is sometimes desirable. A field experiment was installed in California's San Joaquin Valley to test submergence of drains as a means of denitrification. The Panoche silty clay area was irrigated four times during the months of July and August. Samples made of the soil showed that the side of the drain oriented toward the ground water source had the highest reading of nitrate content. This indicated that soil denitrification depends ultimately upon saturation from irrigation as well as sufficient presence of organic carbon matter and a shortage of oxygen. Along with soil denitrification, ground water with high nitrate content was also diluted. (Frantz - East Central(.

1240 - C4

THE PHYSIOLOGY OF THE COLIFORM GROUP,
Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Div. of Water Supply and Pollution Control.
Harold F. Clark, and Paul W. Kabler.
Proc Rudolfs Res Conf, Rutgers Univ, New Brunswick, NJ. Principles and Applications in Aquatic Microbiology, Heukelekian, H and Dondero, Norman C (eds), John Wiley and Sons, Inc, New York, pp 202-229, 1964. 1 fig, 2 tab, 52 ref, disc.

Descriptors: *Bacteria, *Coliforms, *Pollutants, Sanitary engineering, Water, Foods, Soils, Gases, Hydrogen, Carbon dioxide, Fermentation, Plants, Cattle, Grains (Crops), Biochemistry, Microorganisms, Milk, Acid bacteria, Carbohydrates, Physiochemical properties, Animals, Statistical methods, Birds, Human diseases, Sheep, Geographical regions, United States, Inspection, Spores, Hydrogen sulfide, E coli.
Identifiers: *Physiology, *Bacillus coli, Taxonomy, Health, Aerobacter aerogenes, Feces, Glucose, Morphology, Bacterium coli, Bacterium aerogenes, Motility, Coli communis, B lactes-aerogenes, Sucrose, Lactose, Dulcitol, Raffinose, Mannitol, Methyl, Indole, Tryptophan, Ehrlich reaction, Vibrio cholera, Pigs, Types, Acetylmethyl-carbinol, Citrate, Uric acid, Cellobiose, Liquefaction, Eijkman test.

Although the methodologies for distinguishing between the coliform strains of fecal and non-fecal origin are adequate for pollution, the perfect test has not been developed. The gas ratio (Hydrogen:Carbon dioxide) differential test seemed to solve the problem of differentiating the coliform bacteria of fecal origin from those of plant or soil origin but was unadaptable as a routine method. As laboratory procedure, the methyl red test was recommended as of equal value. Since certain assumptions were not valid, its use as a reference procedure was rejected. The property of producing indole from tryptophan has been extensively applied. The indole reaction by coliform bacteria from feces of warm-blooded animals is generally positive in excess of 90 percent, although approximately one-fifth of the coliform bacteria from unpolluted soils can also produce indole. The Voges-Proskauer test, traditionally used as a taxonomic characteristic, is useful in separating fecal from non-fecal coliform group when the data are interpreted statistically. The citrate utilization reaction is useful, on a statistical basis, for separating fecal and non-fecal types. The tests, methyl red, indole, Voges-Proskauer, citrate, none entirely satisfactory individually, combined (IMVIC test), yielded the best classification. The elevated temperature test was superior to other procedures in simplicity. (Jones-Wisc)

1241 - C3, C4

PHYSIOLOGY OF THE RUMEN PROTOZOA,
Agricultural Research Center, Beltsville, Md. Animal Husbandry Research Div.
J. Gutierrez, and R. E. Davis.
Proc Rudolfs Res Conf, Rutgers Univ, New Brunswick, NJ. Principles and Applications in Aquatic Microbiology, Heukelekian, H and Dondero, Norman C (eds), John Wiley and Sons, Inc, pp 394-404, 1964. 2 fig, 1 tab, 17 ref, disc.

Descriptors: *Ruminants, *Protozoa, *Bacteria, Cattle, Reproduction, Metabolism, Amino acids, Tracers, Proteins, Chromatography, Fermentation, Digestion, Lipids, Manometers, Streptococcus, Alfalfa.
Identifiers: *Rumen, *Physiology, Casein, Isotrichs, Holotrichs, Paramecium, Isotricha prostoma, Isotricha intestinalis, Dasytricha, Diplodinium ecaudatum, Entodinium simplex, Ophryoscolex caudatus, Starch, Epidinium ecaudatum, Diplococcus, Peptostreptococcus.

Some functions carried out by rumen protozoa are: producing fatty acids which are absorbed yielding energy to the host; aiding digestion of ingested substrates--starch, cellulose, and bacteria; serving as a source of protein for the host. Tracer experiments showed they are able to incorporate amino acids. As a source of protein, the protozoa furnished 20%

of the host requirement. Protozoan protein was found to have a higher nutritive value than bacterial or yeast protein. Protein contributed to the host was calculated for several protozoa with the cellular nitrogen content experiments. Paper chromatography of acid-hydrolyzed suspensions has indicated a long list of amino acids contained in the protozoal protein, available to the host. The quantitative experiments on ammonia production from casein show that, for some rumen protozoa, ammonia can be an important product of nitrogen metabolism. They contribute to lipid metabolism of the rumen. All the common genera of protozoa are bacteria feeders. Protozoan requirements for growth were studied by in vitro culture work. Of the several media developed, ground rice starch, alfalfa, and Streptococcus bovis, made a successful medium. Attempts to grow the protozoa without living bacteria have been unsuccessful. (Jones- Wisc)

1242 - A9, C4, E2, E3, F5

THE MOVEMENT OF DISEASE PRODUCING ORGANISMS THROUGH SOILS,
California Univ., Davis, Dept. of Civil Engineering.
R. B. Krone.
Symp on Munic Sewage Effluent for Irrig, July 30, 1968, Louisiana Polytech Inst, Ruston, p 75-104, 1968. 30 p, 2 fig, 55 ref.

Descriptors: *Water reuse, *Pathogenic bacteria, *Viruses, *Groundwater movement, Municipal wastes, Irrigation water, Artificial recharge, Filtration, Sorption, Infiltration, Percolation, Soil disposal fields, Soil contamination, Soil physical properties.
Identifiers: Municipal waste recharge.

The movement of pathogenic organisms through soils recharged with contaminated water is discussed. Pathogens have a wide variety of physical and biological characteristics, including wide ranges of size, shape, surface properties, and die-away rates. The processes of filtration by soil include straining at the soil surface, straining at intergrain contacts, sedimentation, and sorption by soil particles. Straining of pathogens at the soil surface and sorption of viruses near the soil surface is desirable because it limits travel of pathogens most, and it is subject to wide variations in temperature and moisture, and it will assure aerobic conditions. A soil containing clay should therefore be used for irrigation with treated sewage. Wide experience in irrigation with treated sewage indicates that it is safe provided that at least primary treatment is used, and provided that the crops are not consumed directly by humans. Secondary treatment and chlorination is recommended for aesthetic reasons. (Knapp-USGS)

1243 - A2, F4

THE IMPACT OF ANIMAL WASTES ON WATER RESOURCES ACTIVITIES,
Kansas Univ., Lawrence, Kans.
Raymond C. Loehr.
Proceedings of the Third Annual American Water Resources Conference, 1967, pp 314-324, 11 p, 2 fig, 2 tab, 28 ref.

Descriptors: *Animal wastes, Wastes, Water pollution sources, Cattle, Fishkill, Waste disposal, Kansas, Runoff, Nitrogen, Drainage, Diseases, Water pollution effects.
Identifiers: Animal production trends, Animal confinement trends, Organic pollution, Inorganic pollution.

Until recently animal wastes have been considered as part of the 'natural' pollution of a region. Animal production is changing from small farm operations into large scale industrial enterprises. There is an increasing trend to confine animals within small areas to produce the greatest weight gain in the shortest period of time. Under such conditions, it is not possible for these animals to drop their wastes on pastures where the wastes can be absorbed by nature without adversely affecting the environment. Animal wastes have been shown to be a major source of surface water pollution. This paper mentions cases of pollution that have been caused by animal wastes and animal production operations. It discusses the trend toward confinement feeding operations and the magnitude of the problem in the future. It also demonstrates the need to consider animal wastes when developing or protecting water resources. (Seneca-Rutgers)

1244 - A9, C4, F5

SURVIVAL OF PATHOGENS AND RELATED DISEASE HAZARDS,
Colorado Univ., Denver. Dept. of Microbiology.
Stuart G. Dunlop.
Symp on Munic Sewage Effluent for Irrig, July 30, 1968, Louiniana Polytech Inst, Ruston, pp 107-121, 1968. 15 p, 1 tab, 62 ref.

Descriptors: *Hazards, *Irrigation water, *Reclaimed water, *Municipal wastes, Pathogenic bacteria, Viruses, Parasitism, Waste treatment, Environmental sanitation.
Identifiers: Waste water irrigation.

The hazards to health caused by irrigation with reclaimed municipal waste water are surveyed. No disease outbreaks have been traced to irrigation with properly treated and disinfected sewage, but many epidemics have been caused by irrigation with improperly treated wastes. The same standards are recommended for effluents as for any other irrigation water. Survival times of pathogenic organisms in water are discussed and tabulated. (K-napp-USGS)

1245 - A2, B1

EFFECTS OF FEEDLOT RUNOFF ON WATER QUALITY OF IMPOUNDMENTS,
Robert S. Kerr Water Research Center, Ada, Okla.
W. R. Duffer, R. D. Kreis, and C. C. Harlin, Jr.
Water Pollution Control Research Series, Environmental Protection Agency July 1971, 53 p, 13 fig, 7 tab, 9 ref, append. EPA Program 16080 GGP 07171.

Descriptors: Reservoirs, *Fishkill, *Ammonia, *Dissolved oxygen, Runoff, *Feedlots, Organic wastes, Nutrients, Phytoplankton, Light penetration, Zooplankton, Bethos, *Farm wastes, Water pollution sources, Cattle.
Identifiers: Solids concentrations.

Effects of rainfall runoff from a beef cattle feedlot on the water quality of a small impoundment were determined. Changes in chemical concentration of impounded water and changes in the community structure of aquatic organisms were measured and related to the amount and composition of feedlot runoff received. Water quality changes were also monitored in a nearby reservoir which received no feedlot runoff to serve as a control. Rainfall from feedlots was retained in collection ponds and pumped into the impoundment over a relatively short period of time, creating in effect a 'slug' discharge conditon. Changes in chemical concentration or population structure of organisms were not apparent for discharges of about one-part feedlot runoff to 40 parts receiving water. Runoff discharges for two pumping periods with each contributing one-fourth of the volume of the receiving water were shown to degrade water quality in the impoundment. Several significant chemical and biological changes occurred. The concentration of salts, solids, oxygen-demanding organic compounds and nutrients increased. Population levels decreased for organisms having negative tolerances for low dissolved oxygen and high ammonia concentrations. The most dramatic reduction in the biological community was the suffocation of about 90% of the game fish in the impoundment. Reduction in population levels of 'stressed' organisms was followed by increased productivity of phototropes in response to higher nutrient concentrations. (Dorland-Iowa State)

1246 - A1, B1, F2

FEEDLOT WASTE MANAGEMENT.
Missouri River Basin Animal Waste Management, Kansas City, Mo. Pilot (Steering) Task Group.

Environmental Protection Agency, June 1971. 45 p, 2 fig.

Descriptors: *Water pollution control, Confinement pens, Cattle, Pollutants, Non-structurel alternatives, Path of pollutants, Water law, Legislation, Regulation, Farm wastes, Livestock, Management, Financing, Missouri River, River basins.
Identifiers: Technical assistance.

Basic information on the problem of beef cattle feedlot waste management and the pollution arising from these operations is presented in a non-technical manner. The factors that cause feedlots to pollute and the magnitude pollutants may reach are discussed along with some management factors and structural and mechanical means to help control water pollution. Sources of technical and financial assistance in design and layout of control facilities and the water pollution control agencies for the ten Missouri River Basin states are listed. Existing animal waste control regulations are also furnished for these ten states. (EPA abstract)

1247 - A1, F2, F5

DISPOSAL OF INDUSTRIAL WASTES.

Oregon Administrative Rules Compilation, ch 340, secs 43-005 thru 43-025 (1970).

Descriptors: *Oregon, *Industrial wastes, *Waste disposal, *Pollution abatement, Water pollution, Ultimate disposal, Regulation, Administrative agencies, Liquid wastes, Organic wastes, Solid wastes, Pollutants, Waste water disposal, Legislation, Legal aspects, Farm wastes, Confinement pens, Hogs, Cattle, Canneries, Industrial plants, Foods, Poultry, Livestock.

Unless the Department of Environmental Quality provides an exemption, all fruit and vegetable processing plants shall provide efficient facilities to remove all suspended and floating materials from the wastes resulting from canning and freezing processing. All solids retained by a standard twenty mesh screen shall be removed from liquid wastes by screening or other approved method and disposed of in a non-polluting manner. Wastes from slaughterhouses and meat packing plants shall be disposed of in a manner that will prevent direct or indirect entry into public waters. All blood shall be collected and disposed of separately from other wastes. Manure and hog stomach contents shall be collected separately and used as fertilizer, land-fill, or in some other approved manner. All fleshings, grease particles, hair and other solid materials shall be collected by dry cleaning of floors and by screening of wastes. Adequate grease recovery basins shall be installed. Similiar provisions govern the disposal of wastes in poultry killing and packing plants. To prevent water pollution from solid wastes, hog feeding yards and holding pens shall be constructed so that they can and will be dry cleaned before being washed down. (Gallagher-Florida)

1248 - A2, A4, F4

LIVESTOCK INDUSTRIES IN TEXAS AS RELATED TO WATER QUALITY, REPORT NUMBER ONE.

Texas Water Quality Board, Austin.
D. Pittman, and P. Harris.
Texas Water Quality Board, Austin, 1970. 30 p, 5 tab, 10 ref.

Descriptors: *Texas, *Water quality, *Livestock, *Farm wastes, *Waste treatment, *Poultry, Wastes, Solid wastes, Cattle, Hogs, Sheep, Waste disposal, Farm management.

Trends are discussed in animal populations in Texas, management techniques employed by animal producers, and characteristics of animal wastes and treatment methods used. In addition, typical and/or economical animal producing units in Texas are described, with an explanation of current practices used to control water pollution caused by animal wastes. A number of conclusions are made from the material presented. The numbers of beef cattle, sheep and poultry in Texas are increasing. There is a trend to confine animals and feed them for more efficient production. Characteristics of animal wastes are variable making it difficult to determine the pollutional effects of the wastes and to recommend adequate treatment. Biological and chemical changes often occur in wastes from confined feeding areas. Conventional domestic waste treatment systems are as yet not feasibly adaptable to animal wastes. Current animal waste management for controlling runoff from confined feeding areas include the use of diversion terraces, ditches and retention ponds with irrigation facilities for dewatering the ponds. (Poertner)

1249 - B1, F2

AGRICULTURAL AND RELATED WASTES CONTROL.

Regulations No. 28-18-1 thru 28-18-4, Kansas Department of Health, Environmental Health Services, Topeka, Kansas, May, 1967. 4 p.

Descriptors: *Waste disposal, *Kansas, *Domestic animals, *Water pollution control, Water pollution, State governments, State jurisdiction, Administration, Regulation, Administrative agencies, Legal aspects, Permits, Standards, Water pollution sources, Treatment facilities, Public health, Cattle, Sheep, Farm wastes, Farms.

The operator of any newly proposed or existing confined feeding operation must register with the department of health. All application forms shall contain information regarding general features of topography, drainage course, and identification of ultimate primary receiving streams. If a confined feeding operation constitutes a water pollution hazard the operator must provide water pollution control facilities which shall be constructed in accordance with plans and specifications approved by the department. Such water pollution control facilities shall not be placed in use until a permit has been issued by the board of health. If a water pollution control facility's permit is revoked, the owner or operator of the confined feeding operation involved shall be allowed to finish feeding existing animals, but may not place any more animals in the feeding area until the minimal requirements are met. The regulation establishes the minimum requirements for water pollution control facilities used for the confined feeding of cattle, swine, sheep, and other animals. All such facilities must be operated and maintained so as to prevent water pollution and protect the public health and the beneficial uses of the state's waters. (Horwitz-Florida)

1250 - A2, A3, A4, A5, C3

DISTRIBUTION OF NITRATES AND OTHER WATER POLLUTANTS UNDER FIELDS AND CORRALS IN THE MIDDLE SOUTH PLATTE VALLEY OF COLORADO,

Agricultural Research Service, Fort Collins, Colo. Northern Plains Branch; and Colorado Agricultural Experiment Station, Fort Collins.
B. A. Stewart, F. G. Viets, Jr., G. L. Hutchinson, W. D. Kemper, and F. E. Clark.
U S Department of Agriculture, Agricultural Research Service, ARS 41-134, December 1967. 206 p. 31 fig, 25 tab, 13 ref.

Descriptors: *Nitrates, *Ammonia, *Water pollution sources, *Cores, Fields, Plants, Alfalfa, Cereal crops, Irrigated land, Colorado, Groundwater, Percolation.
Identifiers: Native grasses, Feedlots, Corrals, South Platte Valley (Colo).

Cores representing nonirrigated fields in native grass, cultivated nonirrigated fields, irrigated fields in alfalfa, irrigated fields in crops other than alfalfa, and corrals were obtained from northeastern Colorado during 1966. Cultivated nonirrigated fields usually contained small accumulations of nitrate below the root zone. Native grass fields, ordinarily, did not show nitrate accumulation in core profiles. Significant quantities of nitrate were found in most cores from irrigated fields with row crops or cereal grains. Alternately, cores from irrigated alfalfa fields generally contained insignificant amounts of nitrate. Amounts of nitrogen as nitrate found under corrals were extremely varied, ranging from almost none to more than 5000 pounds/acre in a 20-foot profile. Evidence disclosed that denitrification was occurring under feedlots, even at several feet below the surface, consequently, much of nitrate under feedlots will probably never reach the water table. Water samples beneath several corrals contained large amounts of organic carbon and ammonia and possessed offensive odor. Bacterial counts under corrals were considerably higher than under other areas, especially at lower depths. These findings indicate some pollution of groundwater by deep percolation is occurring from corrals, but more studies are required before significance and magnitude of this pollution can be assessed. (Keeney-Wisconsin)

1251 - A2, A6, C5

AIRBORNE AMMONIA EUTROPHIES LAKES.

Agricultural Research (USDA), Vol. 19, No. 2, p 8-9, August 1970.

Descriptors: *Ammonia, *Eutrophication, *Nitrogen, Algae, Water pollution sources, Colorado, Cattle, Urine, Path of pollutants, Farm wastes.
Identifiers: Feedlots.

Ammonia traps and rain gages were installed at five sites and in two control areas in Colorado to determine the rate at which ammonia is adsorbed directly from the air by water surfaces under different conditions of temperature and climate at various distances and directions from cattle feedlots. In one northeast Colorado lake a little over a mile from a large feedlot, the surface adsorbed about 30 pounds of nitrogen as ammonia per acre per year. This amount is sufficient to eutrophy a lake averaging 20 feet in depth to two or three times the concentration needed for algal blooms. Indications are that even small feedlots may release enough ammonia to have an effect on nearby water surface and that airborne ammonia from feedlots may contribute more nitrogen than runoff and deep percolation from the same sources. (Mortland-Battelle)

1252 - A2, A4, A9, C3, F4

NITRATE POLLUTION OF WATER,

Illinois State Water Survey, Urbana.
Julius H. Dawes, Thurston E. Larson, and Robert H. Harmeson.
In: Frontiers In Conservation, Proceedings 24th Annual Meeting Soil Conservation Society of America, August 10-13, 1969, Colorado State University, Fort Collins, p 94-102, 1970. 9 p, 8 fig, 6 tab, 6 ref.

Descriptors: *Water pollution sources, *Groundwater, *Surface waters, *Nitrogen compounds, Illinois, Hydrologic cycle, Fertilizers, Industrial wastes, Decomposing organic matter, Organic wastes, Domestic wastes, Livestock, Precipitation (Atmospheric), Water quality, Chemical analysis, Soils, Soil water, Seepage, Sorption, Crops, Nitrates.

Nitrogen levels in surface waters that exceed established standards are evidence of mans intrusion in the environment and the cause of deterioration in water quality. Thirty-nine million tons of chemical fertilizers were applied in the United States in 1967, of which approximately 6 million tons was nitrogen. In Illinois about 25% of all water samples from wells 50 feet deep or less have been found to contain an excessive concentration of nitrate, that is, above the 45 milligrams per liter level. The sources of nitrogen in Illinois surface and subsurface waters are varied and often difficult to identify. Known sources of pollution include precipitation, human wastes, crop residues, decomposing animal or plant tissue, industrial wastes, and nitrogen fertilizer. At the present time there is no known practical and economical way of recovering these excess nitrates. Membrane techniques and biological methods both have potential for preventing pollution of water by nutrients, salts, and minerals, whether the source is fertilizer, irrigation water, sewage, or industrial wastes.
(Woodard-USGS)

1253 - B1, C2, C3, C4, D4

WATER QUALITY CHANGES IN CONFINED HOG WASTE TREATMENT,

Kansas Univ., Lawrence.
Ross E. McKinney, and Robert Bella.
Contrib No 24, Kans Water Resources Res Inst Proj Completion Rep. 1968. 88 p, 21 fig, 12 tab, 13 ref. OWRR Project A-011-KAN.

Descriptors: *Farm wastes, *Waste treatment, *Aerobic treatment, *Hogs, Farm lagoons, Settling basins, Soil disposal fields, Sewage treatment, Disposal, Environmental engineering, Sludge disposal, Waste storage.
Identifiers: Hog farm wastes.

Treatment methods for the wastes of confined hogs are examined. Confined-animal wastes are a major pollution problem. There are about 55 million hogs in the U.S., and their wastes are largely untreated. When they occupy a large area, foraging for food, this is no problem, but under confinement the problem is similar to that of municipal waste disposal. A facility consisting of an aerobic biological treatment system for 10,000 hogs was studied. An important consideration was odor control because of a nearby metropolitan area. Recycled effluent was used for raw-waste input dilution, and paddle-wheel aerators were selected for high oxygen transfer efficiency and low operating cost. Each building had an aeration ditch under its slotted floor for aerobic processing, and final disposal was by a 2-stage infiltration pond system and field spreading of solids. Measurements were made of DO, BOD, COD, pH, suspended solids, N, and trace metals. Chemical analysis results and cost data are tabulated. Operation expense is about 1-2 cents per hog per day. Stream pollution is prevented or greatly reduced and odors are no problem. (Knapo-USGS)

1254 - C4

ISOLATION OF ANAEROBES.

Academic Press, Inc., New York, N.Y. 1971. D.A. Shapton and R. G. Board, editors. 257 p.

Descriptors: *Isolation, *Cultures, Soil bacteria, Protozoa, Fungi, Photosynthetic bacteria, Sulfur bacteria, Nitrogen fixing bacteria, Soil microorganisms, Clostridium, Enteric bacteria, Bioassay, Animal wastes, Poultry, Ruminants, Sediments, Foods, Soils.
Identifiers: *Enumration, Enrichment, Cellulolytic bacteria, Lipolytic bacteria, Bacteriodaceae, Biological samples, Bacteroides fragilis, Sphaerophorus, Fusiformis, Zymomonas anaerobia, Fusobacteria, Spirochaetes, Microaerophilic vibrio, Anaerobes, Culture media, Feces, Tissue, Entodinium caudatum, Entodinium simplex, Epidinium ecaudatum caudatum, Polyplastron multivesiculatum, Actinomyces, Leptotrichia, Veillonella.

Methods are presented for culturing, isolating, and enumerating anaerobic microorganisms including Clostridia; enteric bacteria; anaerobic bacteria of man, ruminants, poultry, and horses; photosynthetic bacteria; nitrogen-fixing bacteria; sulfur bacteria; protozoa; and fungi. The methods are used for isolating the bacteria from animal tissue, food, feces, soil, intestines, bovine rumen and the human mouth. (Holoman-Battelle)

1255 - A2, A9, B1, E4

DISEASES OF FEEDLOT CATTLE,

R. Jensen, and D. R. Mackey.
Lea and Febiger: Philadelphia, Pa. 1971. 2nd Edition. 377 p.
Identifiers: *Animal diseases, Cattle, Feed lots, Farm wastes, Water pollution sources.

Emphasizing the diseases of feedlot cattle, this book brings together current literature pertinent to an expanding branch of veterinary medicine. Each disease is considered under the headings of definition, occurrence, etiology and pathogenesis, clinical signs, postmorten lesions, prevention and treatment. Autopsy findings are presented exactly as practitioners and students should have them to make accurate diagnoses. Carefully selected postmortem and antemortem photographs augment the test. In addition to individual treatments, mass treatments for numerous cattle in a specific lot are described. Many of the newer diseases are discussed, with advice on vaccinations and preventive methods found helpful in their control. Full consideration is given to the causes, clinical signs, diagnosis and treatment of viral bovine rhinotracheitis and other respiratory diseases which cause such serious losses to the cattle fattening industry. All chapters are revised for this edition, with up-to-date information added on treatments, including the use of thiamine hydrochloride for polioencephalomalacia. New preventive measures are discussed, such as the vaccine for the protection against shipping fever. The economic importance of each disease is given and the problems of feedlot pollution of water, soil and air are considered fully. New chapters cover such important topics as preconditioning, adapting cattle to the change in diet from roughage to concentrate, bluetongue, necrotic posthitis and high mountain disease. A subject index is included.–
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1256 — A4, C3, E2

MOVEMENT OF POLLUTANT PHOSPHORUS IN SATURATED SOILS,

University of Minnesota, Minneapolis, Department of Agricultural Engineering.
P. Goodrich.
PH D Thesis, Purdue University, Department of Agricultural Engineering, 1970, 135 p., 3 tab., 57 fig., 49 ref.

Descriptors: *Phosphates, Soil contamination, *Saturated soils, Isotherms, Sands, Diffusion, *Adsorption, Clay, *Soil Columns, Radioisotopes, Denitrification, Waste water (pollution), Electromagnetic waves, Instrumentation, Effluents, *Irrigation, *Water pollution, *Waste disposal, Nutrients, Farm wastes, *Monitoring.
Identifiers: *Radioactive tracer solutions, Scintillator, Automatic data collection, Sandy loam, Land disposal, Influent.

A laboratory experiment was carried out using uniform soil columns and radioactive tracer solutions to monitor movement of phosphorus inside soil columns. An electronic data acquisition system was developed to monitor long term study. Results were compared with adsorption models already developed. Simulated high-phosphate irrigation showed the limited capabilities of surface soil in preventing ground water pollution. Sand and sand loam soils were tested. Results emphasized the importance of clay minerals in phosphate adsorption. However, soils have a finite capacity for adsorbing phosphate, and continuous flushing as in irrigation may cause the phosphate to move quickly to great depths, thus affecting ground water. Therefore, the design of disposal fields must be considered in order to prevent over-accumulation of phosphorus in soil columns. (Frantz - East Central).

1257 - A2, B1, C1, D2, E1

EVALUATION OF BEEF CATTLE FEEDLOT WASTE MANAGEMENT ALTERNATIVES,

Oklahoma Agricultural Experiment Station, Stillwater.
A. F. Butchbaker, J. E. Garton, G. W. A. Mahoney, and M. D. Paine.
Environmental Protection Agency.
Water Pollution Control Research Series, November 1971. 322 p, 61 fig, 51 tab, 94 ref. EPA Program 13040 FXG 11/71.

Descriptors: *Farm wastes, *Feedlots, *Management, *Agricultural runoff, Ultimate disposal, Cost analysis, Water pollution control, Cattle, Operation and maintenance, Separation techniques, Oxidation lagoons, Transportation, *Waste water treatment, *Waste treatment.
Identifiers: *Feedlot waste management alternatives.

Alternative beef waste management systems were examined to determine minimum cost systems for effective waste disposal. Design and cost information was obtained from feedlot visits and the literature. A computer program was developed for use with a Conversational Programming System (CPS) for calculating the sizes of equipment and facilities and for estimating the facility and machinery operating and investment costs. For open feedlots, two waste management systems, solid and runoff-carried, were considered. The total system investment cost for a 20,000 head unpaved feedlot with pollution control was approximately $420,000 with an operating cost of $0.133 per animal day (not including feed mill and storage, office or land costs). The pen facilities were about 65% of the total investment cost, the runoff control system about 10% and the solids handling about 25%. Confinement buildings with slotted floors using slurry handling methods or with solid floors using solid handling methods offer a high potential for completely controlling the animal waste and abating pollution. A promising system for near optimum pollution control is a cable scraper system underneath a slotted floor for daily removal and disposal of the wastes. A manure irrigation system costs about one-half as much as mechanically conveying the slurry to the fields. In semi-arid areas, evaporation lagoons offer another ultimate disposal alternative. (Lowry-Texas)

1258 - A3, A9, C4

RECOVERY OF BACTERIAL PATHOGENS FROM HIGH QUALITY SURFACE WATER,

Colorado State Univ., Fort Collins.
J. F. Fair, and S. M. Morrison.
Water Resources Res, Vol 3, No 3, pp 799-803, 1967. 5 p, 2 tab, 5 ref. Grant WP-00679.

Descriptors: *Water quality, *Aquatic microbiology, *Pathogenic bacteria, *Wildlife, *Livestock, Salmonella, Potable water.
Identifiers: Arizona group pathoginic organisms.

An investigation of the presence of enteric disease producing bacteria in a high quality mountain stream in Colorado yielded 11 isolants of members of the genus Salmonella and 51 isolants of organisms belonging to the Arizona group. An improved method for the recovery of these organisms from high quality water was developed and used successfully. The presence of these potentially pathogenic bacteria, which appeared to be the result of contamination by wild or domestic animals, may be a potential hazard to public health.

1259 - B2, D4

WASTE STABILIZATION PONDS FOR AGRICULTURAL WASTES,

California Univ., Davis; and Kansas State Univ., Manhattan.
Samuel A. Hart, and Marvin E. Turnet.
Advances in Water Quality Improvement, (Editors: Gloyna, E. F., and Eckenfelder, W. W., Jr.), Austin, Texas, Univ of Texas Press, 1968. p 457-463, 2 tab, 6 ref.

Descriptors: *Waste treatment, *Stabilization, *Ponds, *Design criteria, *Anaerobic digestion, Sludge, Disposal, Odors, Mosquitoes, Insect control, Subsurface waters, Infiltration, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD).
Identifiers: *Agricultural wastes, *Manure stabilization pond, *Livestock manure characteristics, *Pond loading rates, *Pond appearance and location, Sludge digestion, Sludge disposal.

In contrast to sewage and other wastewater stabilization ponds, manure disposal ponds are expected to accept very large amounts of organic solid matter, often with scarcely enough water to get the wastes into the pond. The objective is stabilization and disposal of organic matter rather than water purification; effluent is lacking; make-up water is often needed. Biochemical oxygen demand (BOD) loading ranges up to 1200 lbs/acre/day; anaerobic conditions predominate; and are functionally comparable to open unheated sludge lagoons or conventional sludge digesters. Research during the past 5 years confirms dependence on anaerobic processes to stabilize agricultural wastes. Major design criteria are: (1) control odors, (2) control fly and mosquito production, (3) prevent infiltration of pond liquor to subsurface natural waters, (4) proper siting for aesthetic purposes. Other important design considerations relate to: volume and depth criteria, summer sludge upwelling requirements and winter sludge submersion requirements, manure inlet location, sludge build-up rates and removal, pond water levels, effluent runoff control, pond geometry and, plant and insect control. (D'Arezzo-Texas)

1260 — A3, F4

NONPOINT RURAL SOURCES OF WATER POLLUTION,

S. Lin.
ISWS-72-CIR111, Illinois State Water Survey, Urbana, Department of Registration and Education, 1972, 36 p., 20 tab., 4 fig., 84 ref.

Descriptors: *Water pollution, *Rural areas, Fertilizers, Pesticides, Erosion, Sediment, Farm wastes, Nitrogen, Phosphorus, Runoff, Waste treatment, Waste disposal, Illinois.
Identifiers: *DDT, Soil conservation methods.

A literature survey of major sources of rural water pollution was made. Major pollutants are fertilizers, pesticides, erosion and sediment, and animal wastes. In commercial fertilizers, nitrogen and phosphorus pose the greatest pollution threat.. Pesticides are only slightly soluble in water and then only five percent of that applied reaches waterways. Soil erosion and sediment, which carry the greatest threat for pollution, can be minimized by contour farming, terracing, cover crops and/or crop rotation. Farm animal waste treatment may be accomplished by aerobic digestion, lagoons, composting, land disposal, or chemical treatment, however, these are systems used in domestic waste treatment and the same degree of success had not been achieved with animal waste. (Marquard - East Central).

1261 — B1, F1

INTERREGIONAL COMPETITION IN THE CATTLE FEEDING ECONOMY WITH SPECIAL EMPHASIS ON ECONOMIES OF SIZE,

Texas A & M University, College Station, Department of Agricultural Economics and Rural Sociology.
R. A. Dietrich.
Interregional Competition in the Cattle Feeding Economy with Special Emphasis on Economies of Size, B-1115, Texas Agricultural Experiment Station (Project No. HM-2489) in cooperation with the U.S.D.A., September, 1971, 55 p., 39 tab., 8 fig.

Descriptors: *Feed lots, *Cattle, *Economics, *Size.
Identifiers: Regional production characteristics, Transportation rates, Least-cost shipment routes, Feed grains.

This study utilizes a multi-dimensional transshipment model to determine the least cost location and optimum levels of cattle feeding and fed-cattle slaughter among 27 specified regions in the 48 contiguous states to satisfy the demand for fed beef. Data showed that readily available supplies of feed grain and feeder cattle and economies of size in feedlot operations are of major importance in determining the optimum location and levels of cattle feeding. Models were also developed to systematically measure the effects of specified changes in regional feedlot size and projected 1975 regional feedlot sizes on the optimum regional location and levels of cattle feeding and slaughter. In addition, the study shows the least-cost shipment routes for feeder cattle, feed grains, fed slaughter cattle, and dressed fed beef to meet the demand requirements in the various sectors of the cattle feeding-fed-beef economy. (Wether[illegible] - East Central).

1262 — B1, D1, E1, F1

CLIMATE AND THE SELECTION OF A BEEF WASTE MANAGEMENT SYSTEM,

Oklahoma State University, Stillwater, Agricultural Engineering Department.
A. F. Butchbaker, G. W. A. Mahoney, J. E. Garton.
Paper presented at 65th Annual Meeting, American Society of Agricultural Engineers, Hot Springs, Arkansas, June 27-30, 1972, Paper No. 72-410, 35 p., 1 tab., 10 fig., 28 ref.

Descriptors: *Climates, *Feed lots, *Waste disposal, *Cattle, Temperature, Moisture deficit, Aerated lagoons, Management.
Identifiers: *Site selection, *Beef housing system, Anaerobic lagoons.

Climate classifications are defined and climate effects on animals and waste management systems are discussed. As a result, two climatological models for beef housing and waste management were developed to serve as a basis for delineating areas that require different beef housing and waste management practices. One used January and July temperature limits for beef production and moisture deficit. Beef housing and waste management systems were classified by climatological areas. Essentially, more humid areas require more complete housing and waste management systems. Areas of high moisture deficit are optimum for open feedlots. Areas above 60°F require sunshades, and year-around disposal of wastes on croplands can be achieved. Areas below 45°F require a higher degree of housing and storage facilities for winter wastes. (Marquard - East Central).

1263 — B1, C5

CHROMIC OXIDE AND CRUDE PROTEIN EXCRETION IN THE BOVINE AS INFLUENCED BY WATER RESTRICTION,

University of Kentucky, Lexington.
D. L. Cross, J. A. Boling, and N. W. Bradley.
Journal of Animal Science, Vol. 36, No. 5, p. 982-985, May, 1973, 4 tab., 2 fig., 12 ref.

Descriptors: *Farm wastes, *Proteins, *Cattle, Metabolism.
Identifiers: *Chromic oxide,* Water restriction, Dry matter digestibility, Fecal dry matter.

Twelve yearling Angus steers were assigned to two periods and two treatments in an experiment designed to study the effect of water restriction on the excretion of chromic oxide and crude protein. Each steer was confined to a metabolism crate and received 4 kg. of a ration plus water free choice or 60% free choice daily. During each period, fecal samples were taken at 2 hour intervals for 48 hours followed by a 7 day total collection of feces. The percent recovery of chromic oxide averaged 103.1 and 102.3 respectively for the steers offered water free choice or 60% of free choice. There was no difference in the digestion of crude protein between treatments. There was an increase in dry matter digestibility and chromic oxide concentration in fecal dry matter when water was restricted. Water restriction did not affect crude protein concentration of fecal dry matter. These data suggest that water restriction has little effect on the excretion of chromic oxide and crude protein. (Marquard East Central).

1264 — A5, A6, B1, C1, D1

PRINCIPLES OF FEEDLOT ODOR CONTROL,

Texas A & M University, Texas Agricultural Extension Service, Department of Agricultural Engineering.
J. M. Sweeten.
Texas A & M University, Texas Agricultural Extension Service, Department of Agricultural Engineering, December 1, 1972, 8 p., 4 ref.

Descriptors: *Air pollution, *Feed lots, *Farm wastes, Aerobic bacteria, Moisture contents, Temperature, Waste treatment, Poultry, Lagoons, Waste disposal.
Identifiers: *Odor control, Odor measurement, Odor intensity, Odor quality.

The major obstacle in developing effective odor control techniques, writing guidelines for feedlot odor control, and litigation of feedlot odor cases is the lack of suitable quantitative methods for measuring the intensity and quality of odors. Measuring odor intensity is usually done by diluting with odor-free water; however, measurement of odor quality is difficult because of the lack of an accepted standard. The physical variables which affect the generation of malodors from manure are temperature and moisture content. Experiments with poultry manure have shown that manure odor intensities are proportional to moisture content. This has suggested two approaches to odor control of feedlots — (1) maintenance of aerobic conditions for decomposition, and (2) the chemical treatment of manure. Judicious site selection of feedlots with respect to surrounding land use patterns and climatic factors is a third alternative which has had some success. (Dudley - East Central).

SECTION VIII

ACKNOWLEDGEMENTS

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The project staff extends its gratitude to the authors and publishers for use of their publications in these bibliographic entries. Special thanks is also extended to EPA Project Officer, R. Douglas Kreis for his assistance in the preparation of this bibliography.

SECTION IX

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